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ABSTRACT

This curriculum guide consists of a comprehensive list of competency-based performance objectives dealing with selected skill and knowledge competencies considered basic to the preparation of teacher-educators in residential building construction. Thirteen units of instruction subclassified into forty-one teaching sections are included with accompanying statements of objectives and instructional formats. Each section contains suggested teaching activities, instructional methods, instructional materials needed, and references. Also inlcuded are content information sheets, transparency masters, and assignment sheets with answers. The titles of the units are as follow: preconstructional planning; laying out the structure; building foundation masonry/concrete walls; forming, placing, and finishing concrete (horizontal); carpentry (framing the structure); carpentry (enclosing the structure); plumbing (rough-in); heating and cooling (rough-in); electrical (rough-in); carpentry (interior finish); painting and finishing; mechanical trades (completion); and landscape design. (JH)

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ED177343

# COMPETENCY-BASED PRESERVICE CONSTRUCTION TRADES CURRICULUM

STATE BOARD OF EDUCATION
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DEPARTMENT OF ADULT, VOCATIONAL AND TECHNICAL EDUCATION

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# FOREWORD

The Illinois Office of Education/Department of Adult, Vocational and Technical Education is pleased to make available this presentation of instructional strategies for use in acheiving the tasks outlined in the Competency-Based Pre-service Construction Trades Curriculum.

The purpose of this document is to provide the building construction teacher with competency-based skill and knowledge tasks along with an instructional format upon which to build and/or improve the teaching-learning environment in building construction programs.

This publication represents a coordinated effort among several construction trade management and labor organizations. Data collected by the author, as part of a doctoral study conducted at the University of Northern Colorado, School of Industrial Technology, Department of Industrial Arts, was a significant source of information for this curriculum.

The writer wishes to express his gratitude to the many individuals assisting with this project. Those include members of the Illinois Office of Education/Department of Adult, Vocational and Technical Education staff, Eastern Illinois University/School of Technology faculty, members of the Steering Committee, Advisory Committee and supporting staff.

# CAREER AND OCCUPATIONAL EDUCATION
# CURRICULUM MATERIALS ABSTRACT

TITLE OF MATERIALS: Competency-Based Preservice
Construction Trades Curriculum
-Instructional Strategies-

DATE MATERIALS DEVELOPED/REVISED: 1978, 1979

DATE ABSTRACT PREPARED: 6/26/79

NAME OF DEVELOPERS: Howard F. Nelms (original version)
EASTERN ILLINOIS UNIVERSITY
Through contractual agreement with the Illinois Dept. of Adult, Vocational, and Technical Education, Research and Development Section

KEY WORD INDEX
Residential
Construction
Trades
Career
Education

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TYPES OF MATERIALS: ( ) Career Education (X) Occupational Educational

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| ( )Hardcopy | ( )Paper Bound | ( )Video Tape | ( )Film | ( )Slides & Film Strips |
| | | | | xx Loose Leaf 497 Pages |
| ____Pages | _____Pages | ____Minutes | ____Minutes | _____Color |
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| | | ____Color | ____Color | _____Frames |
| | | ____Size | ____Size | Audio ( )yes ( )no |

FOR STUDENT USE: ( )Regular ( )Disadvantaged (X)Other-Students in Building Construction

TARGET LEVEL OF STUDENT: ( )Pre-K thru 6 ( )7-8 ( )9-10 (X)11-12 (X)13-14
( )Adult ( )Teacher (X)Teacher-Education
( )Administrator ( )Other

FOR PROFESSIONAL USE: (X)Teacher-Education (X)Pre-service (X)In-service
( )Classroom Teacher (X)State Personnel
( )Local Administrators ( )Guidance Personnel ( )Other

IS TRAINING REQUIRED FOR OPTIMUM USE OF THESE MATERIALS? (X)Yes ( )No

ARE CONSULTING SERVICES AVAILABLE? (X)Yes ( )No In Illinois
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DESCRIPTOR:

This publication consists of a comprehensive list of competency-based performance objectives dealing with selected skill and knowledge competencies considered basic to the preparation of teacher-educators in residential building construction. Thirteen units of instruction subclassified into forty-one teaching sections are included with accompanying statements of objectives and instructional formats. Each section contains suggested teaching activities, instructional methods, instructional materials needed and references. Content information sheets, transparency masters, assignment sheets and answers to assignment sheets complete this "lesson plan" approach. The titles of the units are as follows:

1.0.0 Preconstruction Planning
2.0.0 Laying Out the Structure
3.0.0 Building Foundation Masonry/Concrete Walls
4.0.0 Forming, Placing and Finishing Concrete - Horizontal
5.0.0 Carpentry - Framing the Structure
6.0.0 Carpentry - Enclosing the Structure
7.0.0 Plumbing - Rough-In
8.0.0 Heating and Cooling - Rough-In
9.0.0 Electrical - Rough-In
10.0.0 Carpentry - Interior Finish
11.0.0 Painting and Finishing
12 0.0 Mechanical Trades - Completion
13.0.0 Landscape Design

The publication was printed in 1979. The original was developed in loose leaf form so that it could be easily updated by inserting new pages, and for teacher convenience in duplicating material for teaching purposes.

STATE ILLINOIS
SUBMITTING
ABSTRACT East Central Curriculum Management Center
Illinois Office of Education
Department of Adult, Vocational and
Technical Education
100 N. First St., E-426
Springfield, Illinois 6277
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# USE OF PUBLICATION

## INSTRUCTIONAL UNITS

The instructional plan utilized in the development of Instructional Strategies for Competency-Based Preservice Construction Trades Curriculum has been written from a lesson plan "point of view".

This lesson plan approach resulted in forty-one individual teaching units. All planning has been arranged, as much as feasible, in the logical sequence one should follow to teach the planning and construction of a residential structure in an educational setting.

Each component of thirteen units of instruction has been color coded for convenience. They appear in each section in the following order.

### STATEMENT OF OBJECTIVES - White

Measurable "unit" and "specific" behavioral or performance objectives, arranged in order of occurrence.

### INSTRUCTIONAL FORMAT - White

The basis for "lesson planning" including suggested activities, instructional methods, instructional materials used and bibliography and A/V resources. For teacher use only

### INFORMATION SHEETS - Green

Information pertaining to unit title in reference to the unit's specific objectives (In outline form in this publication)

### TRANSPARENCY MASTERS - White

Where appropriate, illustrations, graphs, charts, diagrams, schematics and others that enrich or reinforce content

### ASSIGNMENT SHEETS - Tan

Practice or exercise sheets, usually for reinforcement of cognitive learnings presented on information sheets or from lecture/discussion presentations

## ANSWERS TO ASSIGNMENT SHEETS - Pink

Provides answers to the assignments which may be used by the student and/or teacher for checking learner achievement

Careful examination of each instructional unit will assist the teacher in ascertaining:

A. The amount of instructional material that can be taught in the allotted time

B. Skills which must be demonstrated at the building site or classroom

C. Supplementary materials that must be ordered

D. Resource people that are to be contacted

F. Physical needs

1. Supplies

2. Materials

3. Skill practice needed

## STATEMENT OF OBJECTIVES

Each unit of instruction is based on performance objectives. These objectives state the goals of the course for the purposes of providing a sense of direction and achievement for the learner.

Performance objectives have been stated in two forms. TERMINAL OBJECTIVES state the knowledge and skill subject matter to be presented in each section of instruction. SPECIFIC OBJECTIVES state the student performance necessary to achieve the goals as stated in the TERMINAL OBJECTIVES.

The STATEMENT OF OBJECTIVES sheet has been designed for use by the teacher and the learner to provide a common understanding of the intent of the objectives. For improved effectiveness, the learner should read the objectives for each lesson and be encouraged to discuss any questions concerning performance requirements for each instructional unit.

The addition and deletion of objectives is encouraged to allow teachers to alter the content based on student and community needs. Additional content information, assignments and tests must accompany additional objectives.

## INSTRUCTIONAL FORMAT

Each unit of instruction contains an INSTRUCTIONAL FORMAT outlining steps to follow in accomplishing SPECIFIC OBJECTIVES. This information is in outline form and has been prepared for teacher-use. The FORMAT consist of:

I. Suggested Activities

PROVIDES the learner with, and discussion of, TERMINAL and SPECIFIC OBJECTIVES for each section

PROVIDES the learner with course EVALUATION and other MANAGEMENT procedures used by the individual instructor

II. Suggested Instructional Methods

PROVIDES variety of INSTRUCTIONAL METHODS for use in reaching the stated SPECIFIC OBJECTIVES

III. Instructional Materials (used in each section)

PROVIDES TERMINAL OBJECTIVES stating subject matter to be presented in each section of instruction and SPECIFIC OBJECTIVES stating the performance necessary to achieve stated goals in the TERMINAL OBJECTIVE

PROVIDES INFORMATION SHEETS, in outline form, covering lesson content essential for meeting the knowledge objectives of each section. (Detail knowledge information has not been included because of the very broad nature of this curriculum. Only content information, in outline form, has been included.)

PROVIDES TRANSPARENCY MASTERS that reinforces the learning process by seeing as well as hearing the material being presented

PROVIDES ASSIGNMENT SHEETS for each section to give direction to study and furnish experience for writing activities that are intended to develop the knowledge prerequisites to skill development. These may be given to learners for completion in class or used for homework or out-of-class assignment activities

## IV. References

PROVIDES REFERENCES recently published, except in unusual circumstances, where the teacher and/or learner may locate printed information about the subject matter under study. (At this point in time it would be rather difficult to locate any single book suitable for instructional purposes that contains the broad range of content in construction that is presented in this publication. A well equipped construction reference library is recommended for location in the school library or, and perhaps more convenient and usable, in the classroom where cognitive activities are usually centered

# PROJECTED CLASSROOM USE AND EVALUATION
# OF
# CONSTRUCTION TRADES CURRICULUM MATERIALS

## CURRENT STATUS

The recently completed Competency-Based Construction Trades Curriculum (June 1978) and accompanying publication entitled Instructional Strategies (June 1979) provides the content core for two new courses offered in the School of Technology at Eastern Illinois University.

The Construction Teaching Option opens the door for practical application and evaluation of this construction curriculum. In June, 1978 several Illinois building construction teachers and all fifty State Departments of Education were provided a copy of the newly developed construction curriculum.

### Future Dissemination and Evaluation

Inservice programs for the purposes of dissemination and education of practicing construction trades teachers in Illinois are included in Eastern's One and Five Year Plan For Occupational Education Professional Personnel.

Within a five year time span, or sooner, the construction trades curriculum materials will be in the hands of almost all the building construction teachers in Illinois and their students. The task will be completed through the use of this curriculum material at the teacher education level and by the introduction of the material to in-service teachers through various types of workshops, professional meetings, college courses and consultant services of the Illinois Office of Education/Division of Adult, Vocational and Technical Education.

Wide practical application of this type of curriculum project provides possibilities for numerous systems of evaluation.

## NUMBERING SYSTEM EXPLANATION

```
┌─────unit number
│ ┌── section number
0.0.0-performance objective number
```

To expedite the curriculum for quick reference and use a three place numbering system was used. The number holding the first place refers to the unit of instruction. The second place number indicates a section within the particular unit of instruction. The number holding the third place indentifies the performance objective within the designated section.

### THE FIRST PLACE DIGIT REPRESENTS THE UNIT OF INSTRUCTION

| | |
|---|---|
| 1.0.0 | Preconstruction Planning |
| 2.0.0 | Laying Out the Structure |
| 3.0.0 | Building Foundation Masonry/Concrete Walls |
| 4.0.0 | Forming, Placing and Finishing Concrete - Horizontal |
| 5.0.0 | Carpentry - Framing the Structure |
| 6.0.0 | Carpentry - Enclosing the Structure |
| 7.0.0 | Plumbing - Rough-In |
| 8.0.0 | Heating and Cooling - Rough-In |
| 9.0.0 | Electrical - Rough-In |
| 10.0.0 | Carpentry - Interior Finish |
| 11.0.0 | Painting and Finishing |
| 12.0.0 | Mechanical Trades - Completion |
| 13.0.0 | Landscape Design |

### THE SECOND PLACE DIGIT REPRESENTS THE SECTION WITHIN A UNIT

For example, unit #9.0.0 is divided into two sections and numbered respectively, 9.1.0 and 9.2.0

Unit 9.0.0 ELECTRICAL ROUGH-IN
Section 9.1.0 Wiring the Interior
Section 9.2.0 Wiring the Exterior

The reader will recognize a 9.1 number as meaning the Electrical Rough-In unit (9) and Wiring the Interior as section (1)

## THE THIRD PLACE DIGIT REPRESENTS THE PERFORMANCE OBJECTIVES WITHIN A SECTION

Each performance objective within a specific section or unit is put into a suggested order of construction, however the instructor may desire to alter the sequence depending on each situation. The reader will recognize a number 1 in the third place as representing rhe first performance objective within that section. A 2 in the third place represents the second task within that section, 3, 4, continuing to the final performance objective for that particular section.

The number 9.1.1 would be recognized as Electrical Rough-In, the first section Wiring the Interior and the first performance objective within that section of the unit. In a similar manner 7.3.6 is defining the 6th performance objective of the 3rd section (Gas Distribution System) of the 7th unit (Plumbing - Rough-In).

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- Preparing Working Drawings . . . . . . . . . . . . . . 1.6.0
- Writing Specifications . . . . . . . . . . . . . . . . 1.7.0
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- Formwork . . . . . . . . . . . . . . . . . . . . . . . 4.2.0
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# COMPETENCY-BASED PRESERVICE CONSTRUCTION TRADES CURRICULUM

## INSTRUCTIONAL STRATEGIES

by

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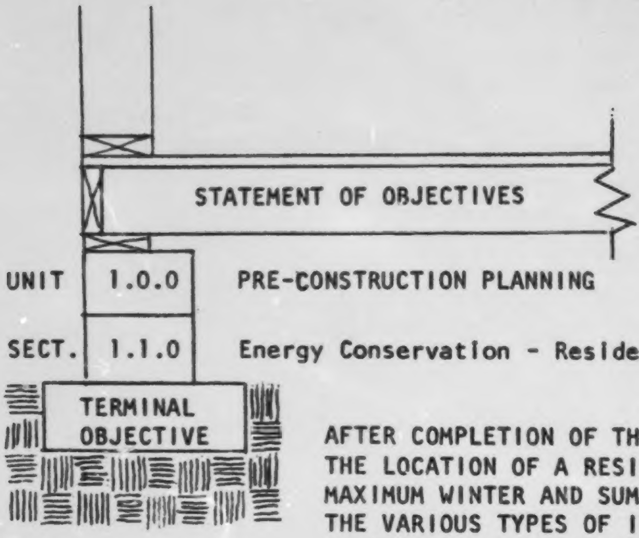
CHARLESTON, ILLINOIS 61920

CONTRACT #RD5-C19-179

September 1, 1978 - June 30, 1979



## STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.1.0 Energy Conservation - Residential Construction Planning Stage

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL ARRANGE THE LOCATION OF A RESIDENTIAL STRUCTURE ON SITE FOR MAXIMUM WINTER AND SUMMER SOLAR ADVANTAGE AND RECOMMEND THE VARIOUS TYPES OF INSULATION AND RELATED MECHANICAL INSTALLATIONS THAT RESULT IN MAXIMUM ENERGY SAVINGS IN THE DESIGN AND CONSTRUCTION OF RESIDENTIAL STRUCTURES.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

1.1.1 Contrast the heat gain of a given building design for an East-West orientation compared to a North-South orientation.

1.1.2 Write the purpose for insulating crawl-space foundations.

1.1.3 Compare basement wall heat loss and the heat loss of the floor directly above the basement.

1.1.4 Name the type of insulation generally used to insulate concrete slab floors exposed to the exterior.

1.1.5 Write four ways in which exterior frame walls may be insulated to a higher R (resistance) factor.

1.1.6 Name six types of insulation that may be used in attics above the ceiling of heated areas.

1.1.7 Compare the heat loss in BTUH among single, double and triple glazed fixed window glass. Base your value on a window of 15 sq. ft. area.

1.1.8 Write two ways to reduce heat loss through and around doors exiting to the exterior.

1.1.9 Sketch the general floor plan (outside walls) of a residential structure that affords the least outside wall exposure through which heat escapes.

1.1.10 Write the primary purpose of roof overhang.

1.1.11 Tell two ways in which a properly designed south wall roof overhang serves as an energy saver.

1.1.12 Explain the primary purpose of a vestibule with an inner door.

1.1.13 Compare the heat loss of a double glazed window with a well insulated wall of the same area

1.1.14 In addition to providing weather protection, explain the thermal advantage of underground living space.

1.1.15 Tell why a chimney should be located on an inside wall of a house.

1.1.16 Tell how cool air may be trapped at inside window locations.

1.1.17 Give one reason why the floor of rooms over unheated areas need be insulated.

1.1.18 Write the purpose of a sill sealer.

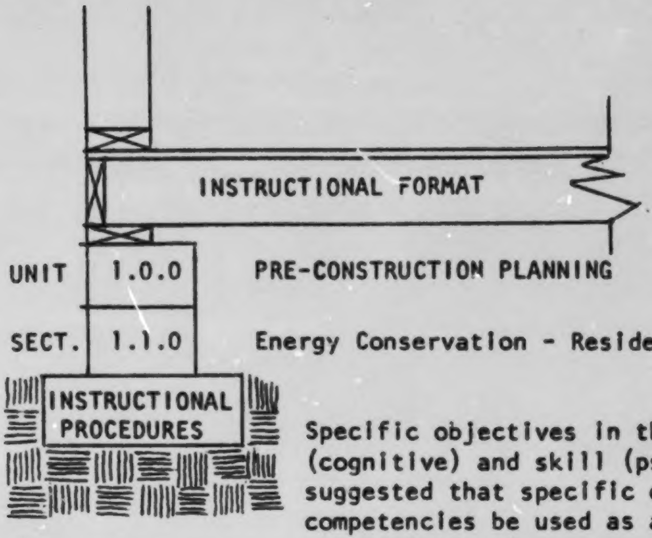
1.1.19 Comapre roof color and attic ventilation in relation to attic temperatures.

1.1.20 Write two primary purposes for attic ventilation.

1.1.21 In what two ways may an extended porch serve to reduce solar heat gain.

1.1.22 Compare solar heat gain through unshaded east and west windows with windows of equal size on south walls.

1.1.23 List six methods of window shading that may be used to reduce solar heat gain.



## INSTRUCTIONAL FORMAT

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.1.0 Energy Conservation - Residential Construction Planning Stage

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

- A. Provide learner with statement of objectives sheet
- B. Discuss terminal and specific objectives
- C. Provide learner with instruction sheets for use with this section
- D. Explain evaluation procedures

II. Suggested instructional methods:

- A. Demonstration - to show manipulative operations at construction site
- B. Discussion - to encourage question and answer activities
- C. Team assignment - to enhance personal relationships in the work environment.
- D. Illustrated lecture - to introduce a lesson or focus attention
- E. Field trips - to illustrate construction techniques and application of materials
- F. Consultant - representatives of any governmental or educational organization who can supply supplemental information related to energy conservation, particularly in the residential construction trades area.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Crawl Space Foundation Insulation/Heat Loss
    - 2. TM 2 - Basement Foundation Insulation/Heat Loss
    - 3. TM 3 - Slab Floor Foundation Insulation/Heat Loss
    - 4. TM 4 - Wall Insulation/Heat Loss
    - 5. TM 5 - Ceiling Insulation/Heat Loss
    - 6. TM 6 - Window and Exterior Door Thermal Protection/Heat Loss
- D. Assignment sheet #1 - Heat Loss Calculations
- E. Answers to assignment sheet #1

IV. References:

- A. Small Homes Council - Building Research Council,"Living With The Energy Crisis". Circular Series C1. 5, Champaign, Illinois: University of Illinois, 1973.

# ENERGY CONSERVATION - RESIDENTIAL PLANNING STAGE
## SECTION 1.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Solar orientation

II. Insulation

  A. Crawl space foundations

  B. Basement walls

  C. Concrete slab floors

  D. Exterior walls

  E. Ceilings

  F. Floors

  G. Unheated areas

III. Glass areas

  A. Double layers

  B. Triple layers

  C. Locations

  D. Sizes

  E. Exterior storm doors

  F. Exterior storm windows

  G. Sky lights

IV. Energy conservation design features

  A. Exterior wall exposure

  B. Roof overhang

  C. Vestibule

D. Window area

E. Underground design

F. Chimney location

G. Draperies

H. Sill plate sealer

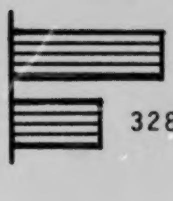
I. Reflective roof surface

j. Attic ventilation

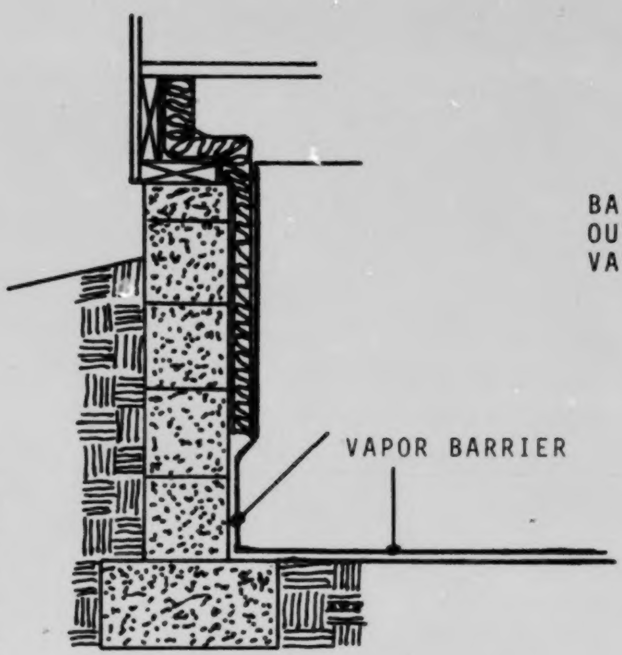
K. Porches

L. Window shading

# FOUNDATION HEAT LOSS

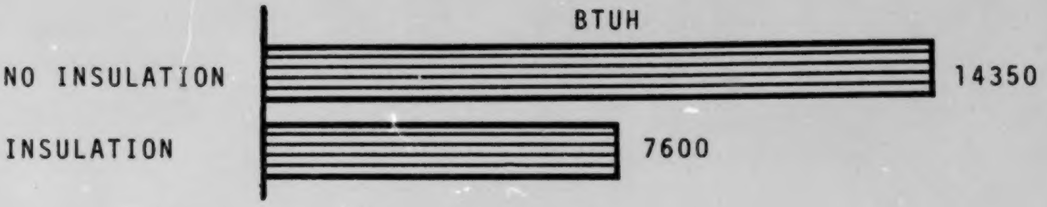


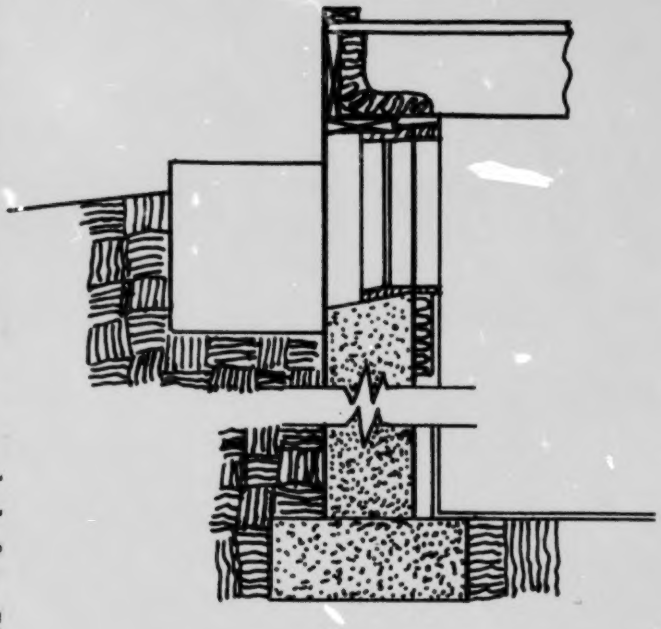
| | LOSS BTUH | CRAWL SPACE | FLOOR SURFACE |
|---|---|---|---|
| NO INSULATION | 6030 | 49.0F | 69.5F |
| INSULATION | 3280 | 61.0F | 72.0F |



BASED ON 30' x 24' FLOOR OVER UNINSULATED CRAWL SPACE
OUTDOOR AIR TEMPERATURE 0°F
VALUES FOR 1000 SQ. FT. AREA

# BASEMENT HEAT LOSS

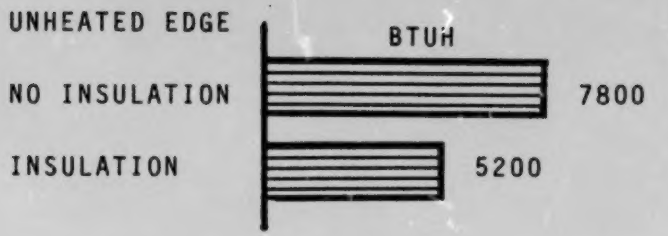


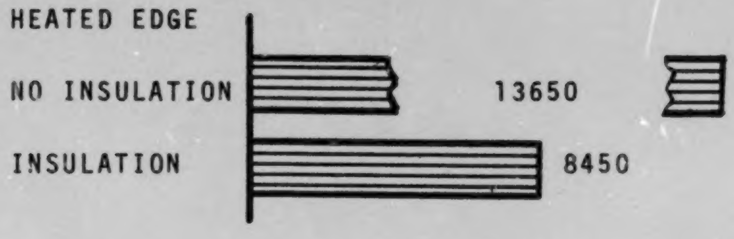


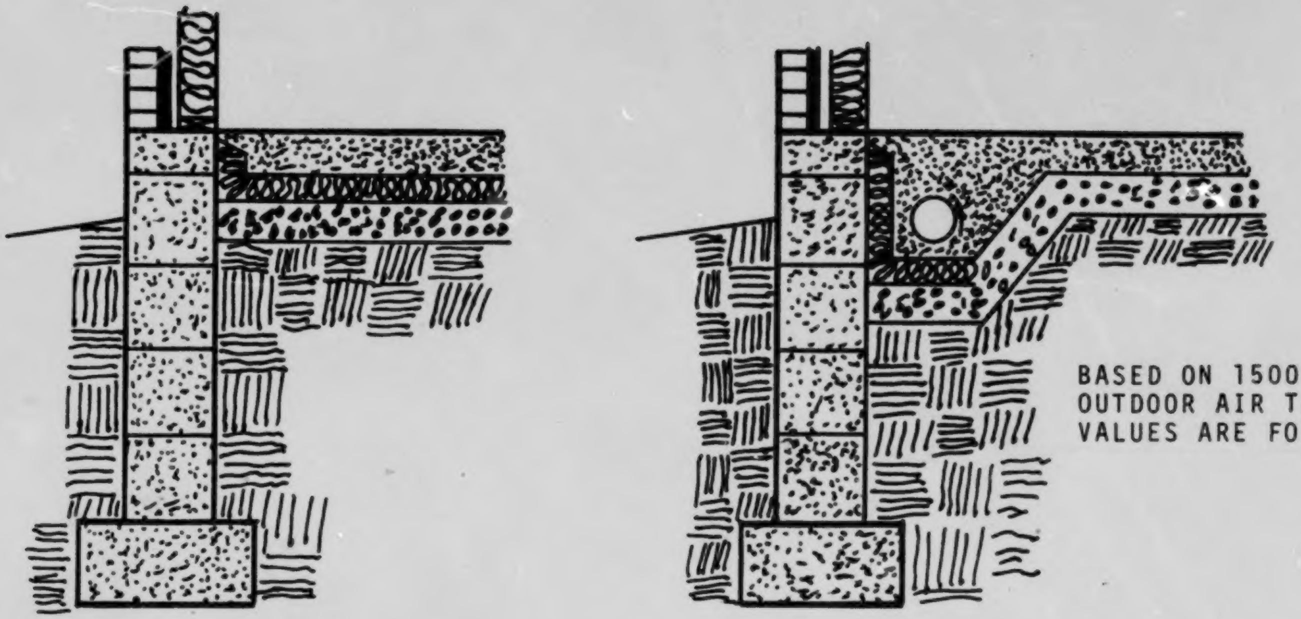
BASED ON 1500 SQ. FT.
OUTDOOR AIR TEMPERATURE $0^{o}$F
VALUES ARE FOR 1000 SQ. FT. AREA

1.1.0 - TM 2

# SLAB FLOOR HEAT LOSS

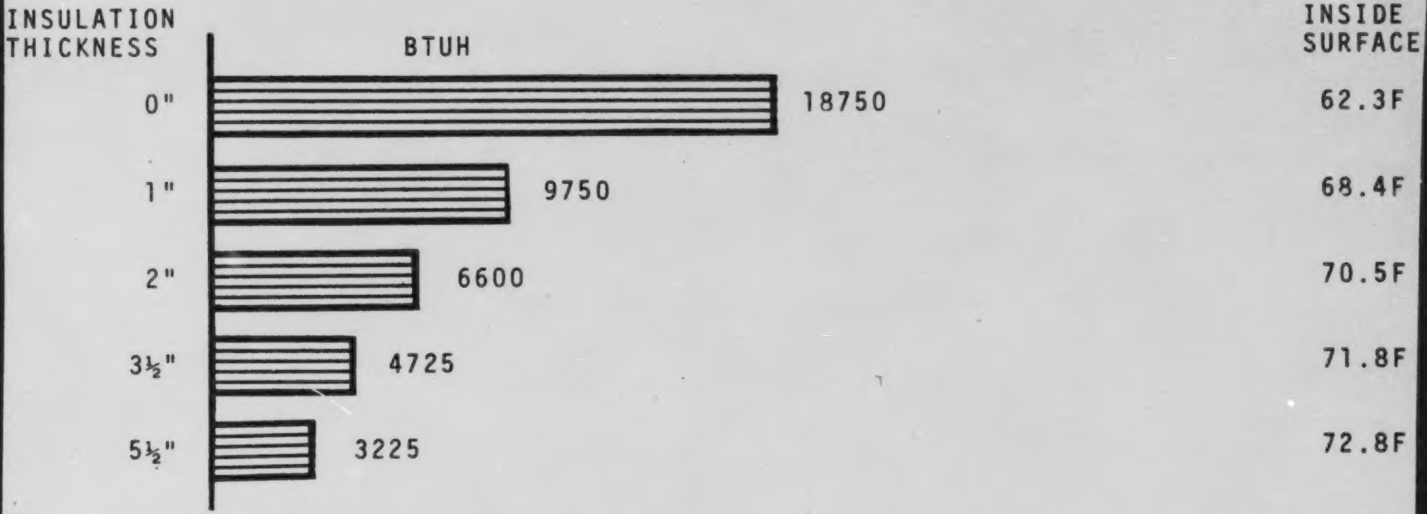






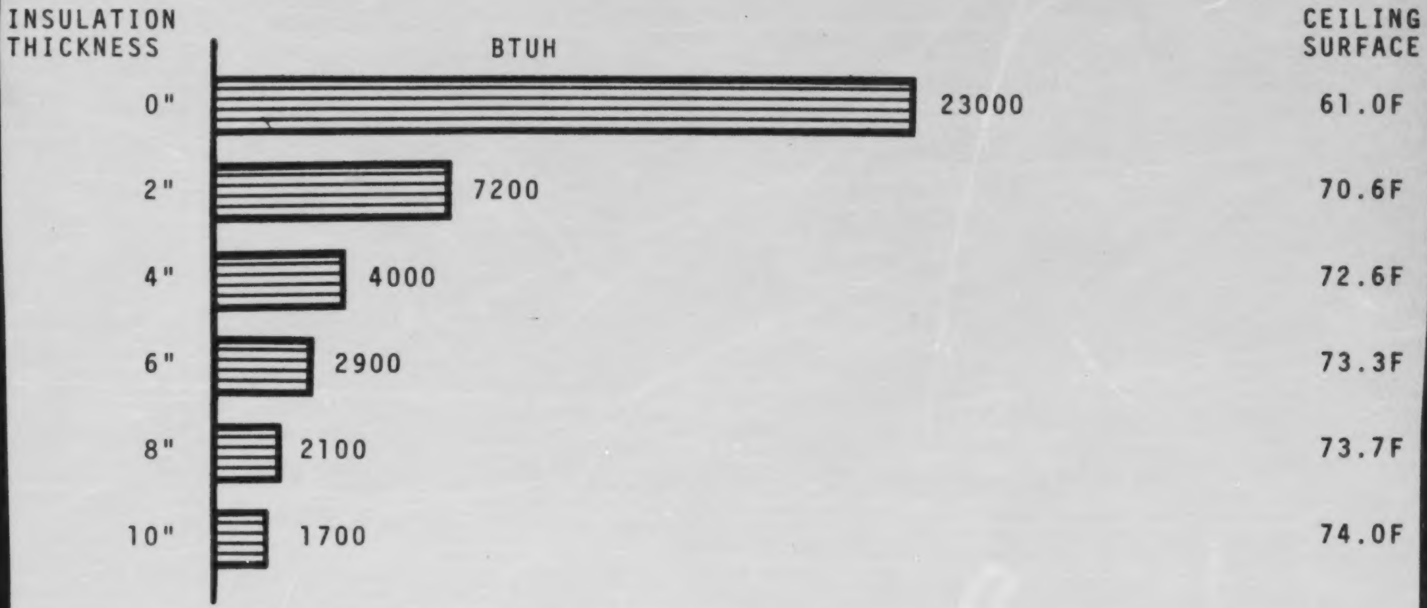
BASED ON 1500 SQ. FT.
OUTDOOR AIR TEMPERATURE 0°F
VALUES ARE FOR 1000 SQ. FT. AREA

# FRAME WALL HEAT LOSS



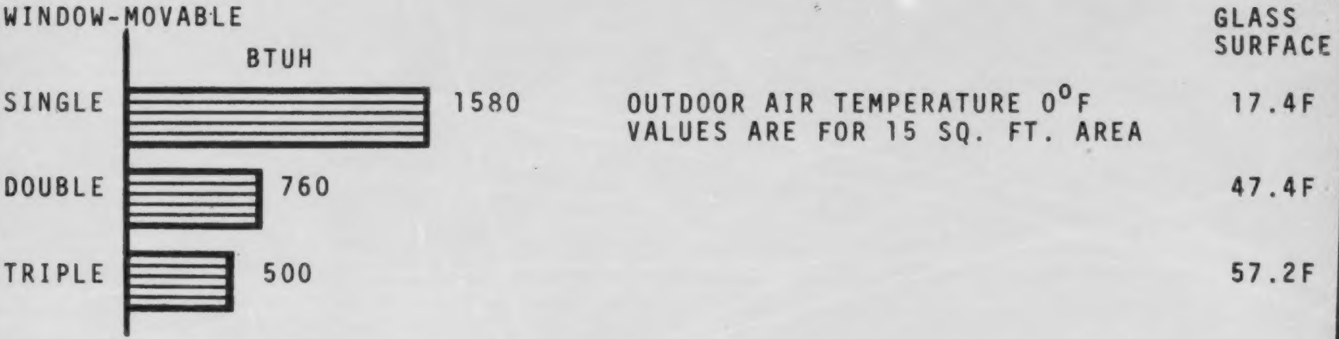
TYPICAL FRAME WALL
OUTDOOR AIR TEMPERATURE 0° F
VALUE FOR 1000 SQ. FT. OF WALL SURFACE (EXCLUDING WINDOWS AND DOORS)

# CEILING INSULATION HEAT LOSS

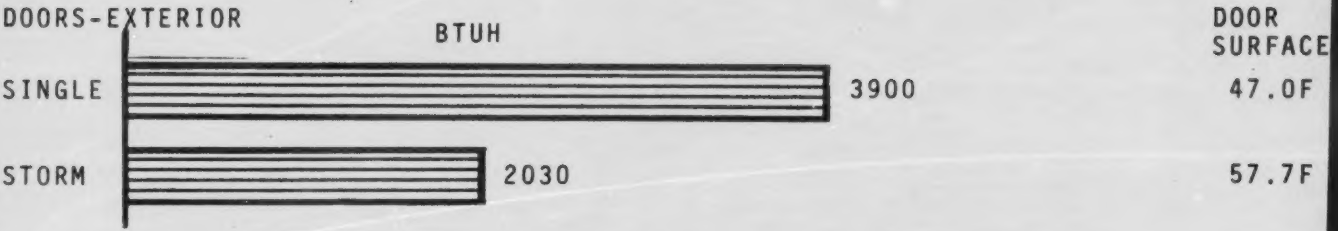


BASED ON 1500 SQ. FT.
OUTDOOR AIR TEMPERATURE 0°F
VALUES ARE FOR 1000 SQ. FT. AREA

# WINDOW & DOOR HEAT LOSS



OUTDOOR AIR TEMPERATURE 0°F
VALUES ARE FOR 15 SQ. FT. AREA



OUTDOOR AIR TEMPERATURE 0°F
VALUES ARE FOR 20 SQ. FT. AREA

# ENERGY CONSERVATION - RESIDENTIAL CONSTRUCTION PLANNING STAGE
## SECTION 1.1.0

## ASSIGNMENT SHEET #1 - HEAT LOSS CALCULATIONS

Using circular series Cl. 5 entitled "Living With the Energy Crisis" developed by the Small Homes Council-Building Research Council, University of Illinois, calculate the difference in heat loss between the items in the schedule below. Present condition shall be the minimum insulation, glass or storm door listed in the fraphs. Heat loss after improvement shall be the maximum amount listed in each graph.

| ITEM | | MINIMUM THERMAL HEAT LOSS | MAXIMUM THERMAL HEAT LOSS |
|---|---|---|---|
| Ceiling | 1,000 sq. ft. | a.________Btuh | g.________Btuh |
| Walls | 1,000 sq. ft. | b.________Btuh | h.________Btuh |
| Windows<br>Movable (10) | 150 sq. ft. | c.________Btuh | i.________Btuh |
| Doors<br>Exterior (2) | 40 sq. ft. | d.________Btuh | j.________Btuh |
| Crawl Space | 1,000 sq. ft. | e.________Btuh | k.________Btuh |
| Total heat loss<br>0° F. outdoors | | f.________Btuh | l.________Btuh |
| Saving difference<br>for 0° F. outdoors | | | m.________Btuh |

Pre-calculated values are for standard frame construction, exposed to 0° F. outdoor temperature, 15 mile per hour wind, and for a 75° F. indoor air temperature. Attic temperature is assumed as 10° F. Each 1,000 Btuh of design heat loss represents 2 to 3 gallons of oil, or 3 to 4 therms of gas, or 55 to 80 kwh of electricity per year for each 1,000 heating degree days in your area.

## ENERGY CONSERVATION - RESIDENTIAL CONSTRUCTION PLANNING STAGE
## SECTION 1.1.0

### ANSWERS TO ASSIGNMENT #1

a. 23,000 Btuh

b. 18,750 Btuh

c. 15,500 Btuh

d. 7,800 Btuh

e. 6,030 Btuh

f. 71,380 Btuh

g. 1,700 Btuh

h. 3,225 Btuh

i. 5,000 Btuh

j. 4,060 Btuh

k. 3,280 Btuh

l. 17,265 Btuh

m. 54,115 Btuh

## STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.2.0 Energy Saving Features - Existing Residential Structures

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL SELECT THOSE RESIDENTIAL ENERGY SAVINGS FEATURES THAT MAY BE APPLIED OR INSTALLED BY THE HOMEOWNER OR TRADESMAN TO EXISTING OR NEW RESIDENTIAL STRUCTURES. IN ADDITION THE LEARNER WILL GIVE AT LEAST ONE SPECIFIC PURPOSE FOR THE USE OF EACH ENERGY SAVING FEATURE OR APPLICATION.

## SPECIFIC OBJECTIVES

After completion of this section, the learner will:

1.2.1 List two purposes for providing adequate air movement out of attics.

1.2.2 Trace the path of floor heat loss to the exterior if band joist insulation is omitted.

1.2.3 Tell how the insulated basement wall can contribute to energy savings.

1.2.4 Explain the primary reason for caulking around doors and windows.

1.2.5 Tell why caulking is recommended at all points where metal or masonry joins with wood building materials.

1.2.6 Explain why all exterior openings for mechanical installations should be caulked.

1.2.7 List the ceiling insulation R (resistance) factor standards for three comfort levels established by the National Mineral Wool Insulation Association and associated manufacturers.

1.2.8 Give the primary reason for using an automatic clock thermostat.

1.2.9 Explain why heating and cooling ducts located in unheated areas should be insulated.

1.2.10 List two consuming products generally used to operate appliances that have been the target of conservation.

1.2.11 Point out how extra insulated hot water tanks may conserve fuel.

1.2.12 Name the mechanical device that will provide both heating and cooling with a high degree of energy efficiency.

1.2.13 Discuss the meaning of EER (energy efficiency ratio) in relation to appliance design.

1.2.14 List the wall insulation R (resistance) factor standard for the comfort levels established by the National Mineral Wool Insulation Association and associated manufacturers.

1.2.15 Explain why a vapor barrier is needed on the ground in crawl space.

1.2.16 Tell how the R (resistance) factor in outside wall construction may be increased by the type of wall sheathing used.

1.2.17 Select the type of perimeter insulation needed to reduce heat loss through slab-on-grade construction at the intersection of the floor and outside foundation wall.

1.2.18 Tell what kind of heat loss may be reduced if insulation is placed behing electrical outlets and plumbing pipes.

1.2.19 Define the term "non-conducting thermal break" as related to windows.

1.2.20 Compare the probability of interior window moisture with single, double and triple glazing.

1.2.21 Point out why oversized heating and cooling equipment decreases efficiency and wastes energy.

1.2.22 Tell how properly sized roof overhangs can reduce solar heat gain at windows by up to 50%.

1.2.23 Tell what kind of heat loss may be reduced by installing sill sealer insulation.

1.2.24 Point out locations and conditions in the United States where solar energy systems are feasible under current technology.

1.2.25 Tell what kind of heat loss may be reduced by installing storm doors.

1.2.26 Describe the interior construction of thermal exterior wood and metal doors.

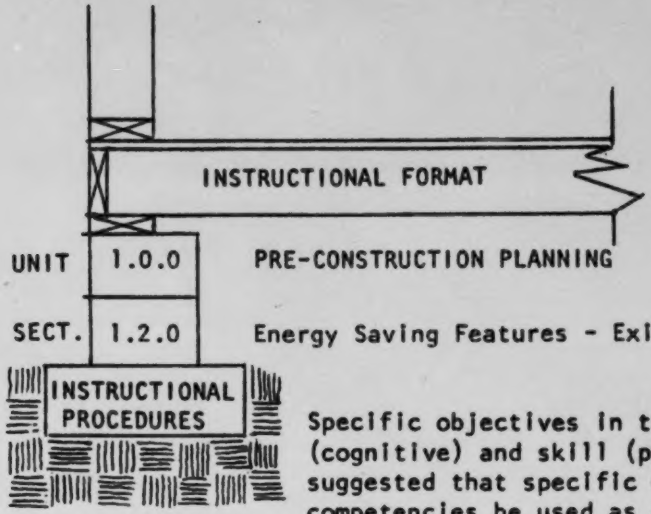
1.2.27 Explain the reason for installing vapor barriers on the warmer side of the insulation.

1.2.28 Point out how water-saving faucets may save energy.

1.2.29 Explain how flow control valves installed in showers may save energy.

1.2.30 Tell what kind of heat loss may be reduced if exterior doors are weatherstripped.

1.2.31 Point out the primary advantage of zone control heating or cooling.



UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.2.0 Energy Saving Features - Existing Residential Structures

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

   A. Provide learner with statement of objectives sheet

   B. Discuss terminal and specific objectives

   C. Provide learner with instruction sheets for use with this section

   D. Explain evaluation procedures

II. Suggested instructional methods:

   A. Demonstration - to show manipulative operations at construction site

   B. Discussion - to encourage question and answer activities

   C. Team assignment - to enhance personal relationships in the work environment.

   D. Illustrated lecture - to introduce a lesson or focus attention

   E. Field trips - to illustrate construction techniques and application of materials

   F. Consultant - representatives of any governmental or educational organization who can supply supplemental information related to energy conservation, particularly in the residential construction trades area.

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Assignment sheet #1 - Insulation Requirements

D. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutching. _Carpentry and Building Construction._ Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Small Homes Council - Building Research Council. "Living With the Energy Crisis". Circular Series CL. 5: Champaign, Illinois: University of Illinois, 1973.

C. Wagner, Willis H. _Modern Carpentry._ South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

## ENERGY SAVING FEATURES - EXISTING RESIDENTIAL STRUCTURE
## SECTION 1.2.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Ventilation

    A. Attic

    B. Clothes dryer

    C. Exhaust fans in kitchen and bath

    D. Crawl space

II. Insulation

    A. Band joist

    B. Basement wall

    C. Ceiling

    D. Wall

    E. Floor

    F. Crawl space

    G. Sheathing

    H. Slab-on-grade

    I. Water pipe

    J. Heating and cooling ducts

III. Air infilteration

    A. Window and door frames

    B. Joining of unlike materials (exterior)

    C. Exterior openings for mechanicals

    D. Interior mechanical installation in exterior walls

    E. Sill
    F. Storm doors
    G. Exterior doors
    H. Windows

IV. Reducing heat loss through glass
    A. Double glazing
    B. Triple glazing
    C. Reduced window glass area
    D. Humidity control

V. Heating and cooling equipment
    A. Sizing of equipment
    B. Solar heating
        1. Residential
        2. Water heating
    C. Clock thermostats
    D. EER (energy efficency ratio)
        1. Appliances
        2. Hot water heater
        3. Heat pump
        4. Central air conditioning
    E. Zoning

VI. Vapor barriers
    A. Purpose
    B. Installation locations

VII. Other energy saving features

A. Thermal breaks

B. Roof overhangs

C. Thermal exterior doors

D. Water saving faucets

E. Water saving shower heads

## ENERGY SAVING FEATURES - EXISTING RESIDENTIAL STRUCTURES
## SECTION 1.2.0

### ASSIGNMENT SHEET #1 - INSULATION REQUIREMENTS

Using the references listed in this section, complete the U-value and insulation "R" number as recommended in the All-Weather Comfort Standard.

### U-VALUES AND INSULATION REQUIREMENTS

| | | INSULATION | |
|---|---|---|---|
| 1. | All weather comfort standard | U-Value | "R" Number |
| | Ceiling | a._____ | d._____ |
| | Walls | b._____ | e._____ |
| | Floors over unheated spaces | c._____ | f._____ |
| 2. | Moderate comfort standard | | |
| | Ceiling | a._____ | d._____ |
| | Walls | b._____ | e._____ |
| | Floors over unheated spaces | c._____ | f._____ |
| 3. | Minimum comfort standard | | |
| | Ceiling | a._____ | d._____ |
| | Walls | b._____ | e._____ |
| | Floors over unheated spaces | c._____ | f._____ |

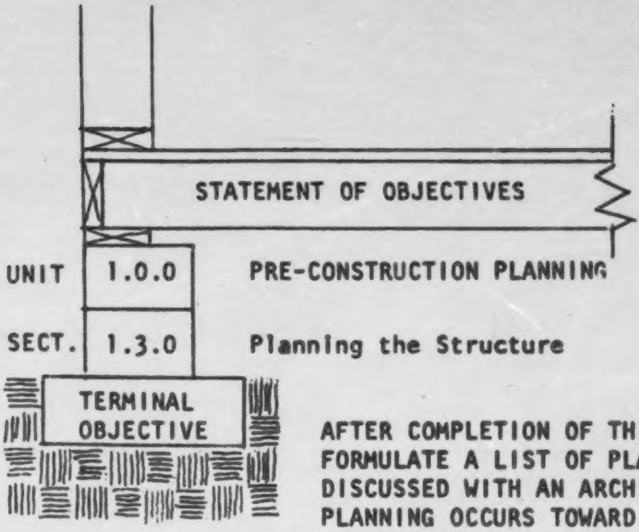
## ENERGY SAVING FEATURES - EXISTING RESIDENTIAL STRUCTURES
## SECTION 1.2.0

## ANSWERS TO ASSIGNMENT #1

1. a. 0.05
   b. 0.07
   c. 0.07
   d. R 19
   e. R 11
   f. R 13

2. a. 0.07
   b. 0.09
   c. 0.09
   d. R 13
   e. R 8
   f. R 9

3. a. 0.10
   b. 0.11
   c. 0.11
   d. R 9
   e. R 7
   f. R 7



## STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.3.0 Planning the Structure

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL FORMULATE A LIST OF PLANNING NEEDS THAT SHOULD BE DISCUSSED WITH AN ARCHITECT OR BUILDER BEFORE EXTENSIVE PLANNING OCCURS TOWARD THE DEVELOPMENT OF A RESIDENTIAL STRUCTURE.

### SPECIFIC OBJECTIVES

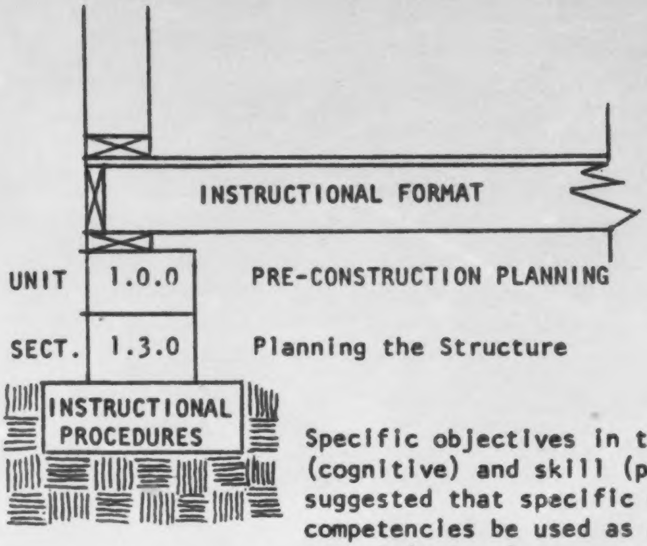
After completion of this section, the learner will:

1.3.1 Compile a list of ten individual and family activities that influence the space needs in a residential structure.

1.3.2 State a generally accepted guide covering the cost a family may safely spend for all housing expenses.

1.3.3 Contrast six basic elements of building design and give one practical example of each.

1.3.4 List ten responsibilities an architect will assume when employed by a prospective new house owner.



INSTRUCTIONAL FORMAT

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.3.0 Planning the Structure

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local lending institutions and architectual firms for current information related to planning responsibilities.

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Space Needs Factors
    - 2. TM 2 - Zoning Factors
    - 3. TM 3 - Space Needs Related In Floor Plan
- D. Assignment sheet #1 - Principles of Building Design
- E. Answers to assignment sheet #1

IV. References:

- A. Kicklighter, Clois E. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.
- B. Spence, William P. Architecture, Design, Engineering, Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# PLANNING THE STRUCTURE
## SECTION 1.3.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Space needs of the individual and family
  A. Public areas of home
    1. Dinning
    2. Entertaining
    3. Accommodating guest
  B. Private areas of home
    1. Family recreation
    2. Hobbies
    3. Studying
    4. Dressing
    5. Sleeping
    6. Relaxing
    7. Storage
    8. Bathing
    9. Housekeeping
  C. Work areas of home
    1. Food preparation
    2. Laundering
    3. Working

II. Estimating shelter cost limitations on income

  A. 1 1/2 to 2 1/2 times annual income after taxes

  B. 20 to 25 percent of the monthly paycheck

  C. Rule-of-thumb estimate not 100% reliable

III. Basic elements of building design

  A. Composition

  B. Proportion

  C. Scale

  D. Contrast

  E. Rhythm

  F. Unity

IV. Architects responsibilities

  A. Clients needs and wishes

  B. Financial status of client

  C. Preliminary plans

  D. Working Drawings

  E. Materials

  F. Contract documents

  G. Specifications

  H. Cost estimates

  I. Bid letting

  J. Contractor reliability

  K. Audit responsibilities

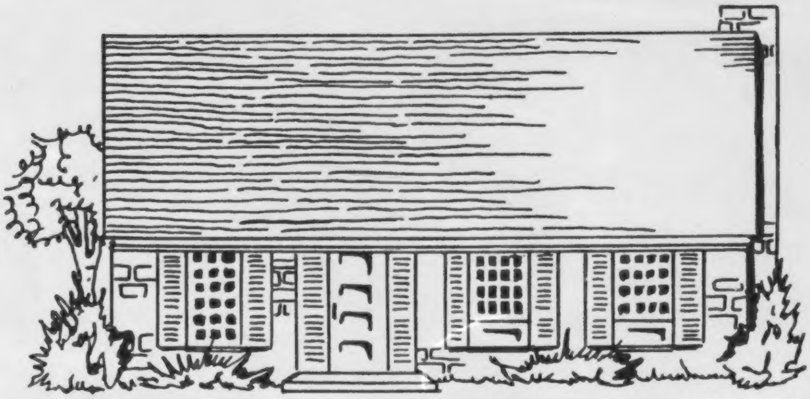
L. Financial disbursements

M. Supervises construction

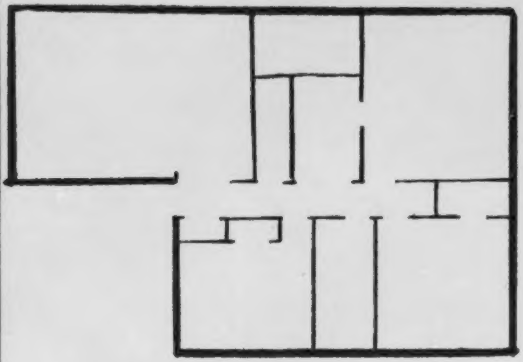
N. Inspection of all labor and material

# SPACE NEEDS FACTORS

EATING, COOKING
RESTING, SLEEPING
BATHING, DRESSING, TOILETING
CLEANING; CARING FOR THINGS
STORAGE
INTERACTING:
  LOUD, QUIET
  TOGETHERNESS, APARTNESS



# ZONING FACTORS



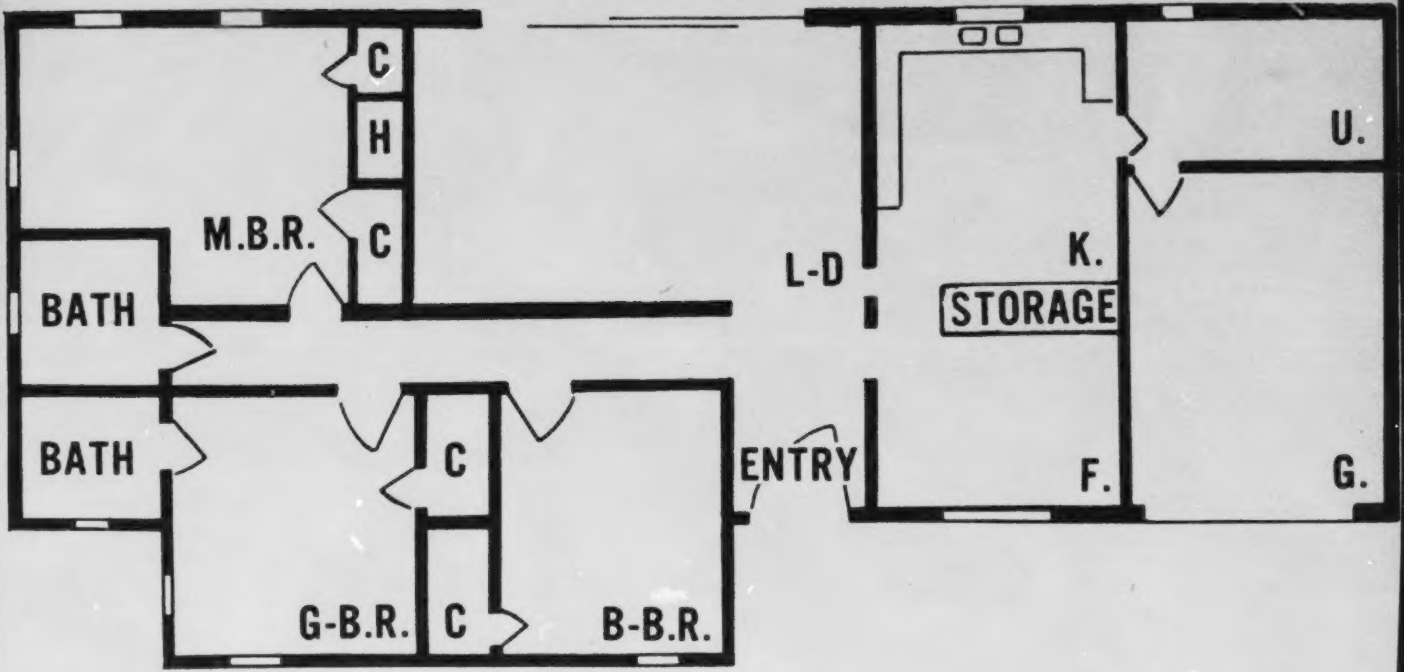
**ROOM**

SIZE
NUMBER
ARRANGEMENT

**FAMILY**

SIZE
AGES
INTEREST

# FLOOR PLAN ZONING



## PLANNING THE STRUCTURE
## SECTION 1.3.0

### ASSIGNMENT SHEET #1 - PRINCIPLES OF BUILDING DESIGN

Match the definitions on the right to the basic principles of building design on the left.

DESIGN ELEMENT

1. Composition______
2. Symmetrical______
3. Asymmetrical_____
4. Proportion_______
5. Contrast_________
6. Unity____________

DEFINITION

a. The relation of the size of one thing to the size of another

b. The mass and details of the structure seem to belong together

c. Tends to relieve monotomy by use of various materials and design

d. Is built on a centerline with windows spaced an equal distance on each side of the centerline

e. Gives a feeling of balance by having unlike portions of the structure grouped around a focal point

f. Combining of the parts of a house to achieve a harmonious whole

Calculate how much money the average family should spend toward the construction of a house. (A generally accepted standard ranges from 1 1/2 to 2 1/2 times yearly gross income before deductions.) Calculate the amount based on the following annual incomes.

## SHELTER COST LIMITATIONS - INCOME BASIS

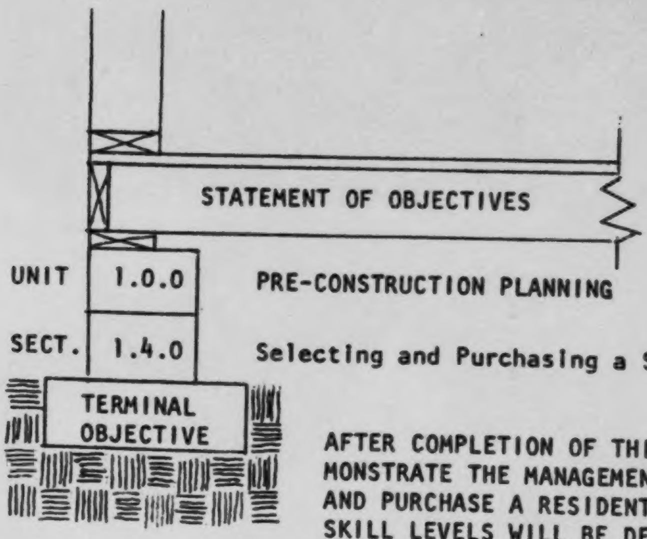
| ANNUAL GROSS<br>Income Before Deductions | TOTAL COST LIMITATION<br>1 1/2 Times | To | <br>2 1/2 Times |
|---|---|---|---|
| 5,000 | 7.________ | | 12.________ |
| 10,000 | 8.________ | | 13.________ |
| 15,000 | 9.________ | | 14.________ |
| 20,000 | 10.________ | | 15.________ |
| 25,000 | 11.________ | | 16.________ |

Currently, the average new home selling price in the United States is $67,000 and rising.

## PLANNING THE STRUCTURE
## SECTION 1.3.0

### ANSWERS TO ASSIGNMENT #1

1. f
2. d
3. e
4. a
5. c
6. b
7. 7,500
8. 15,000
9. 22,500
10. 30,000
11. 37,500
12. 12,500
13. 25,000
14. 37,500
15. 50,000
16. 62,500



## STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.4.0 Selecting and Purchasing a Site

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL DEMONSTRATE THE MANAGEMENT SKILLS NECESSARY TO SELECT AND PURCHASE A RESIDENTIAL BUILDING SITE. PROFICIENCY SKILL LEVELS WILL BE DEMONSTRATED IN THE USE OF SELECTED CRITERIA UPON WHICH TO EVALUATE POTENTIAL CONSTRUCTION SITES. CRITERIAL FOR EVALUATION WILL INCLUDE NEIGHBORHOOD EVALUATION, TOPOGRAPHICAL INFORMATION, ZONING, BUILDING CODES, UTILITY SERVICES AND PURCHASING PROCEDURES.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

1.4.1 List ten neighborhood evaluation criteria one should consider prior to the purchase of a residential building site.

1.4.2 Write ten topographical pieces of information a prospective purchaser should investigate before the site purchase is consummated.

1.4.3 Compare three different zoning classifications usually used to regulate orderly city growth.

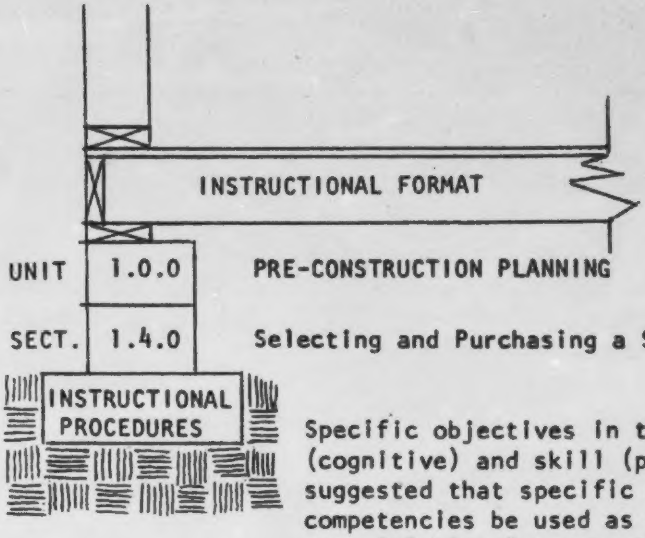
1.4.4 Acquire a list or write the local residential building code restrictions for plumbing, electrical, and building construction.

1.4.5 Identify four utility services available locally and compare the installation services provided by each utility firm.

1.4.6 List the principal purpose for a title search, deed to real estate, and easements attached to property.

1.4.7 Identify, in order of occurrence, three steps customarily followed when purchasing a site for construction purposes.

1.4.8 Differentiate the load bearing capacities (in tons per square foot) of soft clay and sandy loam, firm clay and dry fine sand, and hard dry clay.



UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.4.0 Selecting and Purchasing a Site

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local city government, such as zoning board members, building inspectors, utility representatives, community planning commissions and representatives of local lending institutions that feature home loans.

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Residential Building Permit Application
  - 2. TM 2 - Residential Building Permit
- D. Assignment sheet #1 - Selecting And Purchasing A Site
- E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Kicklighter, Clois E. and Ronald J. Baird. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.

C. Spence, William P. Architecture Design Engineering Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

## SELECTING AND PURCHASING A SITE
## SECTION 1.4.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Neighborhood evaluation
    A. Planned community
    B. Price range
    C. Socioeconomic category
    D. Vitality
    E. Growth potential
    F. Resident pride
    G. Service quality
    H. Service availabity
    I. Employment vicinity
    J. Public transportation
    K. Rate of resale
    L. Tax structure

II. Topographical features
    A. Slope
    B. Contour
    C. Shape
    D. Size
    E. Elevation
    F. Trees
    G. Rocks

- H. Soil condition
- I. Boundaries
- J. Orientation
    - 1. Sun
    - 2. Winds
    - 3. Views
    - 4. Privacy

III. Zoning classifications

- A. Single family residential
- B. Multiple family
- C. Commercial

IV. Residential building code restrictions

- A. National codes
    - 1. Building
    - 2. Electrical
    - 3. Plumbing
- B. Local
    - 1. Building
    - 2. Electrical
    - 3. Plumbing
- C. Purpose
- D. Building inspections
    - 1. Permit costs
    - 2. Inspections
    - 3. Regulations

V. Utility services

   A. Electricity

   B. Natural gas

   C. Water

   D. Sewer facilities

   E. Garbage and trash collection

VI. Legal procedures

   A. Title search

   B. Deed

      1. Easements

VII. Steps leading to purchasing

   A. Survey

   B. Deed

   C. Abstract of title

VIII. Soil load bearing capacities (tpsf)

   A. Soft clay sandy loam

   B. Firm clay and dry fine sand

   C. Hard dry clay

# RESIDENTIAL BUILDING PERMIT

(APPLICATION)

PERMIT NO.__________

DATE ISSUED__________

LOCATION: STREET AND NUMBER______________________________________

LEGAL DESCRIPTION: (1) LOT_______BLOCK_____SUBDIVISION__________________

OR (2) METES AND BOUNDS DESCRIPTION:______________________________

______________________________________________________________

______________________________________________________________

AREA ZONED_______LOT SIZE______LOT AREA__________________________

FRONT SET BACK______________ ESTIMATED VALUE ____________

SIDE SET BACK______________ FEES

REAR SET BACK______________ USE PERMIT $____________

SIDE SET BACK______________ BUILDING PERMIT ____________

PUBLIC ALLEY______________ TOTAL FEES ____________

NO. OF OFF STREET PARKING SPACES_______

NO. OF DWELLING UNITS______________ IS THERE CITY WATER ____________

TOTAL AREA OF LIVABLE FLOOR SPACE_______ IS THERE CITY SEWER____________

OWNER____________________ADDRESS________________PHONE ____________

ARCHITECT________________ADDRESS________________PHONE____________

CONTRACTOR_______________ADDRESS________________PHONE____________

I CERTIFY THAT THE ABOVE STATEMENT IS TRUE TO THE BEST OF MY KNOWLEDGE.

______________________________

OWNER OR AGENT

______________________________

SUBSCRIBED AND SWORN TO BEFORE ME THIS

_____DAY OF___________19___

______________________________

NOTARY

FOR USE OF BUILDING OFFICER:

APPROVED; DISAPPROVED; THIS

_____DAY OF________________19_______

______________________________

BUILDING AND ZONING OFFICER

______________________________

60

1.4.0 - TM 1

# RESIDENTIAL BUILDING PERMIT

AUTHORITY IS HEREBY GIVEN________________________________________

TO BEGIN CONSTRUCTION IN ACCORDANCE WITH THE PLANS AND APPLICATION FOR BUILDING PERMIT HERETOFORE FILED WITH THE BUILDING AND ZONING OFFICER FOR A BUILDING TO BE LOCATED AT

NO.________________STREET____________________________________________

THIS APPLICATION IS APPROVED AND THIS PERMIT GRANTED ON THE EXPRESS CONDITION THAT THE SAID CONSTRUCTION SHALL BEGIN WITHIN 90 DAYS AND IN ALL RESPECTS CONFORM TO THE ORDIANCES OF THE CITY OF CHARLESTON, REGULATING THE CONSTRUCTION OF BUILDINGS, AND MAY BE REVOKED AT ANY TIME UPON THE VIOLATION OF ANY OF THE PROVISIONS OF SAID ORDIANCES, AND THAT AN OCCUPANCY PERMIT WILL BE OBTAINED BEFORE THE BUILDING IS OCCUPIED.

ISSUED THIS_____DAY OF ______________19___

____________________________________
BUILDING AND ZONING OFFICER

OTHER PERMITS NEEDED:

____________________________________

____________________________________

____________________________________

# SELECTING AND PURCHASING A SITE
## SECTION 1.4.0

## ASSIGNMENT SHEET #1 - SITE LOCATION, BUILDING CODES, ZONING LAWS AND PURCHASE PROCEDURES

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

______1. Local laws specifying the type of structure that may be built in a specified location.

______2. A zoning classification

______3. Collection of laws listed in booklet form that apply to a given community.

______4. Addresses problems and standards in the southern states.

______5. Reveals any legal claims against property.

______6. Shows restrictions or easements attached to property.

______7. History of legal transactions affecting ownership of property.

______8. Shows boundaries of the property.

______9. Provide for the health, safety and general welfare of people in the community and the dwelling occupants.

_____10. Safe load of soils in tons per square foot of footing bearing surface for firm clay.

a. Abstract of title

b. 2 tons psf

c. Basic purpose of building code

d. Local building code

e. Single family residential

f. Deed

g. Survey

h. Southern Standard Building Code

i. Zoning laws

j. Title search

# SELECTING AND PURCHASING A SITE
## SECTION 14.0

## ANSWERS TO ASSIGNMENT #1

1. i
2. e
3. d
4. h
5. j
6. f
7. a
8. g
9. c
10. b

## STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.5.0 Planning The Living Space

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL BE ABLE TO APPLY BASIC PRINCIPLES OF ROOM PLANNING TOWARD THE DEVELOPMENT OF A SINGLE FAMILY RESIDENCE. THE LEARNER WILL BE AWARE OF AND INCORPORATE INTO THE PLANNING THE FACTORS THAT ARE ESSENTIAL TO INSURE EFFICIENT TRAFFIC FLOW.

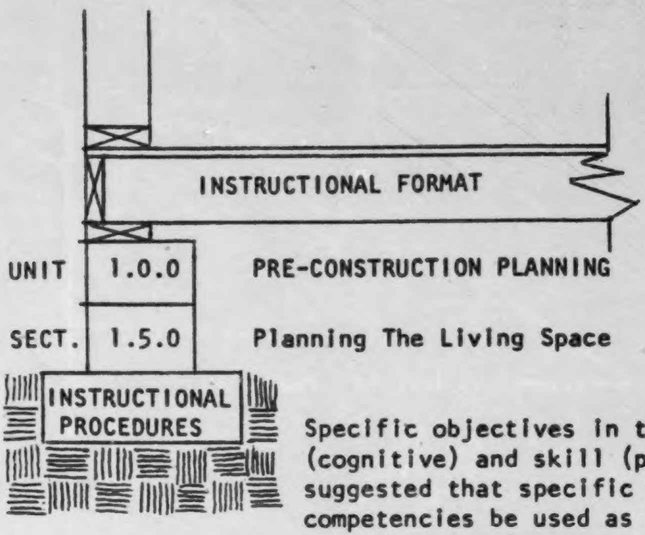
### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

1.5.1 Make a scale freehand sketch on graph paper of a floor plan for a single family residential structure to include the sleeping, living, service, work and private areas according to Federal Housing Minimum Property Standards for single family residence. Scale is to be 1/4" = 1'0".

NOTE: A SUITABLE FLOOR PLAN FROM AVAILABLE PRINTED MEDIA MAY SERVE AS A GUIDE FOR PRIMARY ROOM LAYOUT.

1.5.2 List a minimum of ten factors to consider when planning a residential structure for efficient traffic flow.



## INSTRUCTIONAL FORMAT

**UNIT 1.0.0 PRE-CONSTRUCTION PLANNING**

**SECT. 1.5.0 Planning The Living Space**

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local architectual firms or educational agencies that specilizes in residential house planning.

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Assignment sheet #1 - Living Space Area

D. Answers to assignment sheet #1

IV. References:

A. Kicklighter, Clois E. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.

B. Spence, William P. Architecture Design Engineering Drawing. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

## PLANNING THE LIVING SPACE
## SECTION 1.5.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Designing individual rooms

  A. Size

  B. Furniture templates

  C. Sealed freehand sketch

  D. Window and door locations

II. Planning the sleeping area

  A. Space requirements of total sleeping area

  B. Bedrooms

    1. Number

    2. Grouping

    3. FHA size requirements

      a. Small (100 sq. ft.)

      b. Average (125 to 175 sq. ft.)

      c. Large (over 175 sq. ft.)

    4. Closet requirements

      a. Minimum of four linear feet of rod for men

      b. Minimum of six linear feet of rod for a woman

      c. Minimum dept

      d. Location

    5. Window location and spacing

    6. Door location and minimum widths

7. Private baths
8. Door swing direction

C. Bathrooms
1. Locations
2. Number of bathrooms
3. Size minimum (5' x 8')
4. Primary fixtures
5. Location of fixtures
6. Style of fixtures
7. Standard sizes of fixtures
8. Ventilation
9. Accessibility
10. Door swing direction

III. Planning the living area

A. Space requirement of total living area

B. Living rooms
1. Purpose - life style
2. Sizes
3. Location
    a. Proximity to dining room
    b. Extension to patio
    c. Elevation
    d. Traffic flow

C. Dining rooms
1. Purpose - life style
2. Size

    3. Location
    4. Open verses closed
    5. Traffic flow

D. Entryway and foyer
    1. Types of entryways
        a. Main
        b. Service
        c. Special purpose
    2. Main entryways
        a. Location
        b. Weather protection
        c. Size
        d. Door style
    3. Service entrance
    4. Special purpose entrance
    5. Foyer
        a. Function
        b. Closet
        c. Size
    6. Hall
        a. Function
        b. Widths

E. Family recreation rooms
    1. Purpose
    2. Location
    3. Size

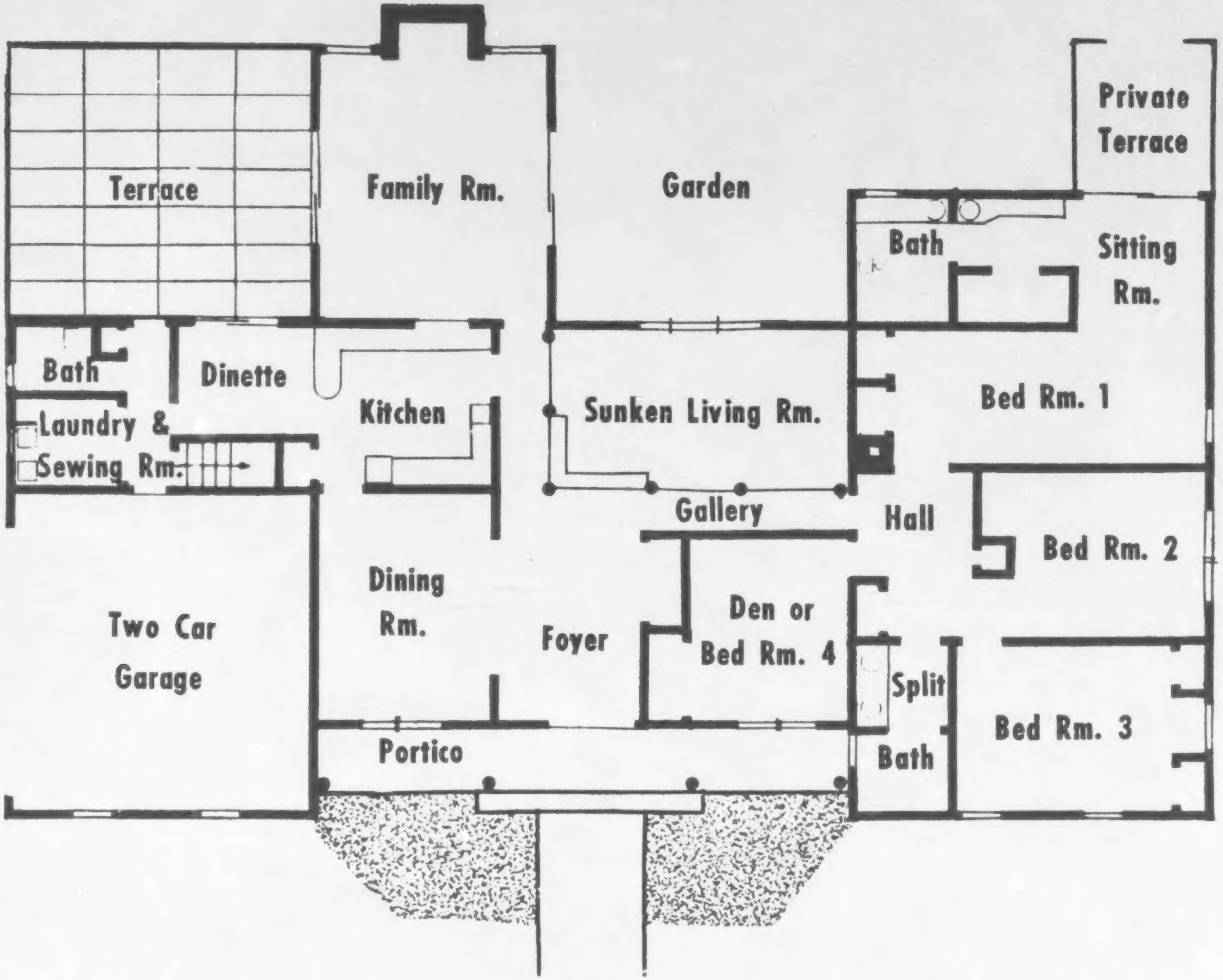
F. Patios, porches and courts
1. Purpose
2. Location
3. Privacy

IV. Planning the service area
A. Space requirements of total service area
B. Kitchen
1. Principal use
2. Work triangle
3. Basic style
a. Straight line
b. "L" shaped
c. Corridor
d. "U" shaped
e. Peninula
f. Island
4. Cabinets
5. Standard size appliances
C. Clothes care center
1. Purposes
a. Washing
b. Drying
c. Pressing
d. Folding
e. Storage

        - f. Mending
        - g. Sewing
    - 2. Special features
        - a. Floor
        - b. Storage
        - c. Ventilation
    - 3. Location
- D. Garage or carport
    - 1. Free standing or attached
    - 2. Location
    - 3. Sizes
    - 4. Storage
    - 5. Garage vs carport
    - 6. Door design
    - 7. Floor drain
    - 8. Floor slope
    - 9. Driveway

## ASSIGNMENT SHEET #1 - LIVING SPACE AREAS

Lightly color the sleeping, living and service areas of the floor plan depicted below. Colors should be blue for sleeping, red for service, and white for living areas.



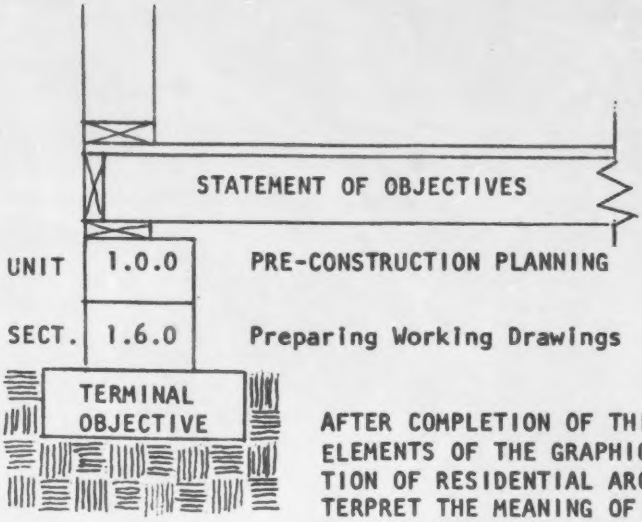
## PLANNING THE LIVING SPACE
## SECTION 1.5.0

## ANSWERS TO ASSIGNMENT #1

1. Sleeping area (blue)
   - a. Bedroom #1
   - b. Bedroom #2
   - c. Bedroon #3
   - d. Bedroon #4 if used as bedroom

2. Living area (white)
   - a. Living room
   - b. Dining room
   - c. Foyer
   - d. Family room
   - e. Portico
   - f. Terrace
   - g. Private terrace
   - h. Gallery
   - i. Hall in bedroom area
   - j. Hall in service area

3. Service area (red)
   - a. Kitchen
   - b. Laundry and sewing room
   - c. Garage
   - d. Bath in service area



## STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.6.0 Preparing Working Drawings

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL DEFINE ELEMENTS OF THE GRAPHICAL LANGUAGE EMPLOYED IN THE PREPARATION OF RESIDENTIAL ARCHITECTUAL WORKING DRAWINGS AND INTERPRET THE MEANING OF VARIOUS ARCHITECTUAL SYMBOLS AS RELATED TO CONSTRUCTION MATERIALS AND PROCESSES GENERALLY EMPLOYED.

### SPECIFIC OBJECTIVES

SPECIAL NOTE: IT IS HIGHLY PROBABLE THAT SOME STUDENTS AT THIS POINT WILL HAVE LEARNED SEVERAL OF THE DRAFTING COMPETENCIES OUTLINED IN THIS SECTION THROUGH PREVIOUS EXPERIENCES IN ARCHITECTUAL DRAFTING COURSES. CONSEQUENTLY, THIS SECTION HAS BEEN PREPARED ON THE BASIS OF INTERPRETING WORKING DRAWINGS GENERALLY INCLUDED AS A "SET" OF ARCHITECTUAL BLUEPRINTS FOR A SINGLE FAMILY RESIDENCE. STUDENTS ARE ENCOURAGED TO DEVELOP THESE COMPETENCIES IF TIME AND RESOURCES ARE MADE AVAILABLE.

After completion of this section, the learner will:

1.6.1 Draw a plot plan for a residential structure according to Federal Housing Minimum Property Standards for Single Family Residences. Scale is to be 1" = 1' - 0".

1.6.2 Draw a floor plan for a residential structure according to Federal Housing Administration Minimum Property Standards for Single Family Residences. Scale is 1/4" = 1' - 0".

1.6.3 Draw a foundation/basement plan for a residential structure according to Federal Housing Administration Minimum Property Standards for Single Family Residences. Scale is 1/4" = 1' - 0".

1.6.4 Make drawings of each elevation for a residential structure according to Federal Housing Administration Minimum Property Standard for Single Family Residences. Scale is 1/4" = 1' - 0".

1.6.5 Design and draw an electrical plan for a single family residence to meet local and national electrical code specifications.

NOTE: THE FLOOR PLANS MAY BE USED TO DRAW THE ELECTRICAL PLAN.

1.6.6 Draw detail/section drawings of exterior wall, stair wells, landings and stairs, roof trusses, fireplace, kitchen cabinets indicating shelving, and special critical construction points. Select scale and complete to Federal Housing Administration Minimum Property Standards for Single Family Residence.

1.6.7 Make a two-point perspective drawing of a single family residence illustrating how a finished structure will look. Scale is to be 1/4" = 1' - 0".

1.6.8 Following local/national building codes, draw a roof plan for a single family residence.

NOTE: THE ROOF PLAN MAY BE INCLUDED ON THE PLOT PLAN.

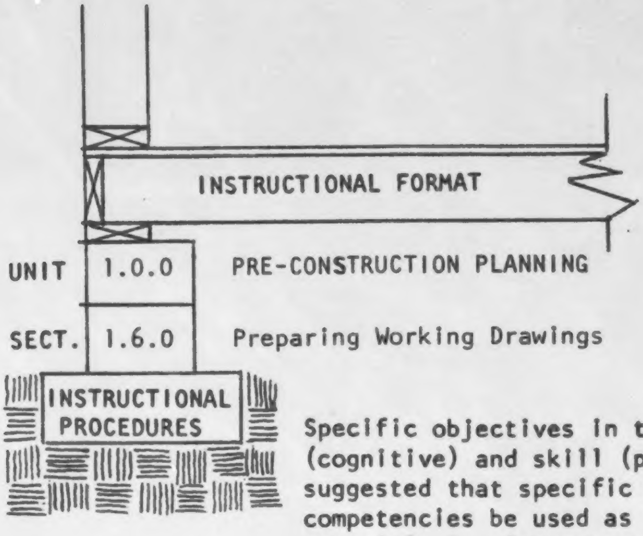
1.6.9 Draw a roof framing plan for a single family residence that shows the rafters, ceiling joists, and supporting members. Draw to specifications provided by local/national building code requirements.

1.6.10 Draw a floor framing plan to local/national building code requirements for a single family residence. Include direction of floor joists and major supporting members.

1.6.11 Select a commonly used fuel available locally for heating and cooling a single family residence and draw a heating/cooling plan in compliance with the National Warm Air Heating and Air Conditional Association or other FHA recognized associations.

1.6.12 Draw a plumbing plan for a single family residence in compliance with the local/state/National Plumbing Code and FHA Minimum Property Standards for single family residences.

1.6.13 Draw a landscape plan including suitable automobile and pedestrian access from street to dwelling, grading of site to provide division and disposal of surface water, lawn/ground cover, trees and shrubs, retaining walls and fences. Installations are to be in compliance with Federal Housing Administration Minimum Property Standards for single family residence.



## INSTRUCTIONAL FORMAT

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.6.0 Preparing Working Drawings

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local architectural firms, educational institutions, materials supply firms, and public utilities for supplemental information related to the design and preparation of working drawings for the construction of single family residences.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Architectural Line Symbols
    - 2. TM 2 - Plot Plan
    - 3. TM 3 - Topographical Symbols
    - 4. TM 4 - First Floor
    - 5. TM 5 - Floor Plan Symbols
    - 6. TM 6 - Basement
    - 7. TM 7 - Materials Symbols
    - 8. TM 8 - Elevation Plans
    - 9. TM 9 - Elevation Symbols
    - 10. TM 10 - Electrical Plan
    - 11. TM 11 - Electrical Symbols
    - 12. TM 12 - Electrical Symbols - continued
    - 13. TM 13 - Electrical Symbols - continued
    - 14. TM 14 - Wall Section
    - 15. TM 15 - Plan Views of Roof Frames
    - 16. TM 16 - Heating Symbols
    - 17. TM 17 - Heating Symbols - continued
- D. Assignment sheet #1 - Reading Working Drawings
- E. Answers to assignment sheet #1

IV. References:

A. Kicklighter, Clois E. and Ronald J. Baird. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.

B. Spence, William P. Architecture-Design, Engineering, Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# PREPARING WORKING DRAWINGS
## SECTION 1.6.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Architectural line symbols
   - A. Object lines
   - B. Hidden lines
   - C. Center lines
   - D. Extension lines
   - E. Dimension lines
   - F. Long break lines
   - G. Short break lines
   - H. Cutting plane lines
   - I. Section lines
   - J. Guidelines
   - K. Construction lines
   - L. Leader lines

II. Plot plan
   - A. Description
   - B. Specific information included
     - 1. Length and bearing of each property line
     - 2. Location, outline and size of buildings on site
     - 3. Land contour
     - 4. Elevation of property corners and contour lines
     - 5. Meridian arrow (north direction)
     - 6. Location of vegetation

        7. Exterior auto and human transportation facilities
        8. Location of utilities
        9. Easements (if any)
        10. Well water supply
        11. Sewage disposal (self contained)
        12. Fences and retaining walls
        13. Address of site, lot number or street number
        14. Scale of drawing
        15. Topographical symbols
    C. Property lines
        1. Bearing angles
        2. Bench mark
    D. Contour lines
    E. Topographical features
    F. Location of structure on site
    G. Landscape plot plans

III. Floor plan
    A. Description
    B. Purpose
    C. Specific information included
        1. Exterior and interior walls
        2. Size and location of windows and doors
        3. Built-in cabinets and appliances
        4. Permanent fixtures
        5. Stairs and fireplaces

    6. Walks, patios and decks
    7. Room identification
    8. Material symbols
    9. Dimensions, size and location
    10. Scale

D. Location and size of walls

    1. Wall thickness
    2. Material symbols

E. Location and size of windows and doors

    1. Extension line locations
    2. Width representations
        a. Sash
        b. Door
    3. Sills
    4. Door swing
    5. Plain opening

F. Built-in cabinets and appliances

    1. Location and size dimensions
        a. Kitchen cabinets
        b. Bathroom vanities
        c. Fixtures and appliances

G. Stairs

    1. Basic size and location information
    2. Direction of stair flight
    3. Number of risers
    4. Width of stairs

H. Fireplace

  1. Symbols

  2. Basic width, length, location and shape of opening

I. Walls, patios and decks

  1. Size

  2. Materials

J. Room identification

  1. Lettering size (3/16)

  2. Location

  3. Size information

    a. Reading position

    b. Dimension sequence

      1. First room dimension (left to right)

      2. Second room dimension (top to bottom)

K. General dimensioning techniques

  1. Everything is dimensioned the actual size, even though it is drawn to scale.

  2. Dimensions should not be crowded. Keep them at least 1/4 inch from the drawing and each other.

  3. An unbroken dimension line should be used; the dimension should be placed above it.

  4. Distances over 12 inches are recorded as feet and inches. If the distance is an even number of feet, record the inches with a zero, i.e., 12' - 0".

  5. Dimensions are placed on a drawing so they can be read from the bottom or right side of the drawing.

  6. Every drawing and detail should have the scale indicated, even though on the same page and drawn to the same scale.

7. Anything unusual should be explained with a note. Notes are lettered horizontally.

8. Materials, electrical devices and plumbing fixtures are recorded by symbols.

L. Scale

1. Standard scale
2. Paper size
3. Numbering individual sheets

IV. Foundation/basement plan

A. Description

1. Foundation
2. Basement

B. Information included on basement plan

1. Windows and doors
2. Columns and girders
3. Heating system
4. Footings
5. Laundry facilities
6. Garage
7. Recreation room
8. Floor joist direction
9. Scale
10. Material symbols

V. Elevation plans

A. Definition

B. Purpose

C. Elevation identification
    1. Methods
    2. Location on drawing
D. Reference points
    1. Grade line
    2. Finished floor line
    3. Finished ceiling line
E. Exterior walls
F. Windows and doors
    1. Horizontal placement
    2. Vertical placement
    3. Window and door details
G. Roof features
    1. Style
    2. Pitch
    3. Chimney
    4. Details
        a. Flashing
        b. Roof material
        c. ventilators
        d. Vent pipes
        e. Gutters
H. Dimensions
    1. Vertical height emphasized
    2. Features to be dimensioned
        a. Footing thickness

    - b. Footing to grade
    - c. Finish floor to finish ceiling
    - d. Overhang width
    - e. Window and door height
    - f. Top of chimney above roof ridge
    - g. Scale
  - 3. Note information
    - a. Grade information
    - b. Exterior wall material
    - c. Roof covering material
    - d. Fascia material
    - e. Flashing material
  - 4. Symbols

- VI. Electrical plan
  - A. Definition
  - B. Purpose
  - C. Specific required information
    - 1. Service entrance capacity
    - 2. Meter location
    - 3. Distribution panel location
    - 4. Placement and types of switches
    - 5. Location and type of lighting fixtures
    - 6. Special electrical equipment
    - 7. Number and types of circuits
    - 8. Electrical fixtures schedule
    - 9. Symbols and legend

  10. Notes to help describe elements of the system
  11. Scale

D. Service enterance
  1. Types
  2. Location
  3. Size
  4. Meter location

VII. Construction detail plans

A. Definition

B. Items generally detailed
  1. Stairs
  2. Cabinets
  3. Fireplace
  4. Cornice
  5. Girder
  6. Pier
  7. Special window problems

C. Scales for details (3/8)

VIII. Framing plans

A. Roof
  1. Plan view
  2. Identify structural members

B. Floor
  1. Plan view
  2. Identify structural members

C. Scale

IX. Heating and cooling plan

   A. Definition

   B. Specific information included

      1. Size and location of distribution pipes or ducts

      2. Location of thermostats, registers or baseboard

      3. Location and type of heating/cooling equipment

      4. Equipment schedule

      5. Heat loss calculations

      6. Location and type of ventilating equipment

      7. Location and type of humidification equipment

      8. Location and type of air cleaning equipment

      9. Notes to help describe system

X. Plumbing plan

   A. Description and purpose

   B. Wastelines and vent stacks

      1. Location and size

      2. Main stack

      3. Minimum pipe sizes

      4. Slope

      5. House drain location

   C. Water supply lines

      1. Building main

      2. Treatment devices

      3. Pipe sizes

   D. Drain and fixture locations

      1. Storm sewer connections

      2. Fixture clearances

E. Size and type of pipe

1. FHA minimums

2. Code requirements

3. Types

F. Plumbing fixture schedule

1. Information included

a. Identifying symbols

b. Fixture name

c. Number needed

d. Manufactures and catalogue number

e. Pipe connection sizes

2. Remarks

G. Symbols and legend

1. Commonly accepted plumbing symbols

2. Non-standard plumbing symbols (includes legend)

H. Notes

1. Materials

2. Installation procedures

3. Details not shown by drawings

XI. Landscape plot plan

A. Purpose

B. Information included

1. Boundary lines

2. Meridian arrow

3. Outline of house

4. Driveway, walks, patios

5. Contour lines

C. Plant information

   1. Symbols

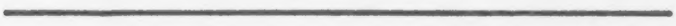
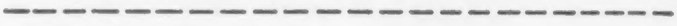
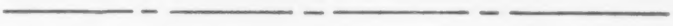
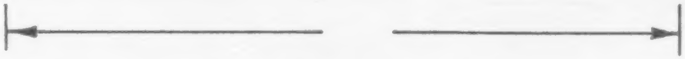
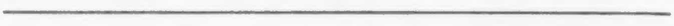
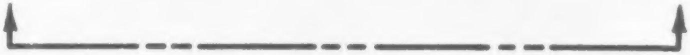
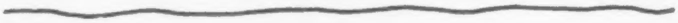
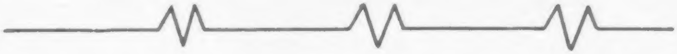
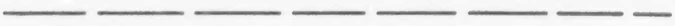
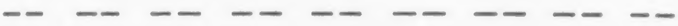
   2. Tree and shrub schedule

      a. Key

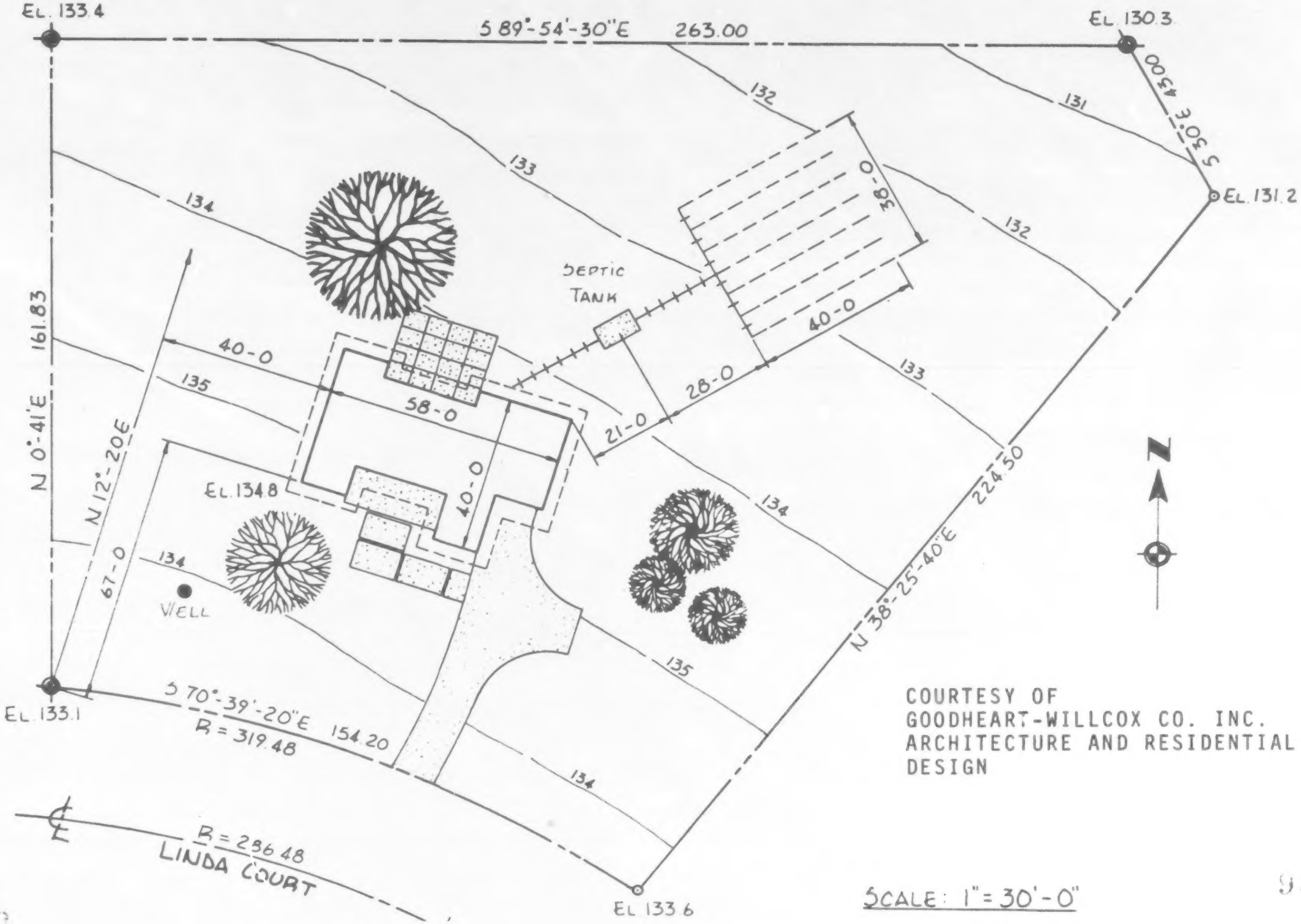
      b. Quality

      c. Plant description

# ARCHITECTURAL LINE SYMBOLS

| | | |
|---|---|---|
| OUTLINE |  | HEAVY |
| HIDDEN LINE |  | MEDIUM |
| CENTER LINE |  | LIGHT |
| DIMENSION LINE |  | LIGHT |
| SECTION LINE |  | LIGHT |
| CUTTING PLANE LINE |  | HEAVY |
| BREAKLINES |  | MEDIUM |
| |  | LIGHT |
| ALTERNATE POSITION |  | LIGHT |
| DITTO LINE |  | LIGHT |

# PLOT PLAN

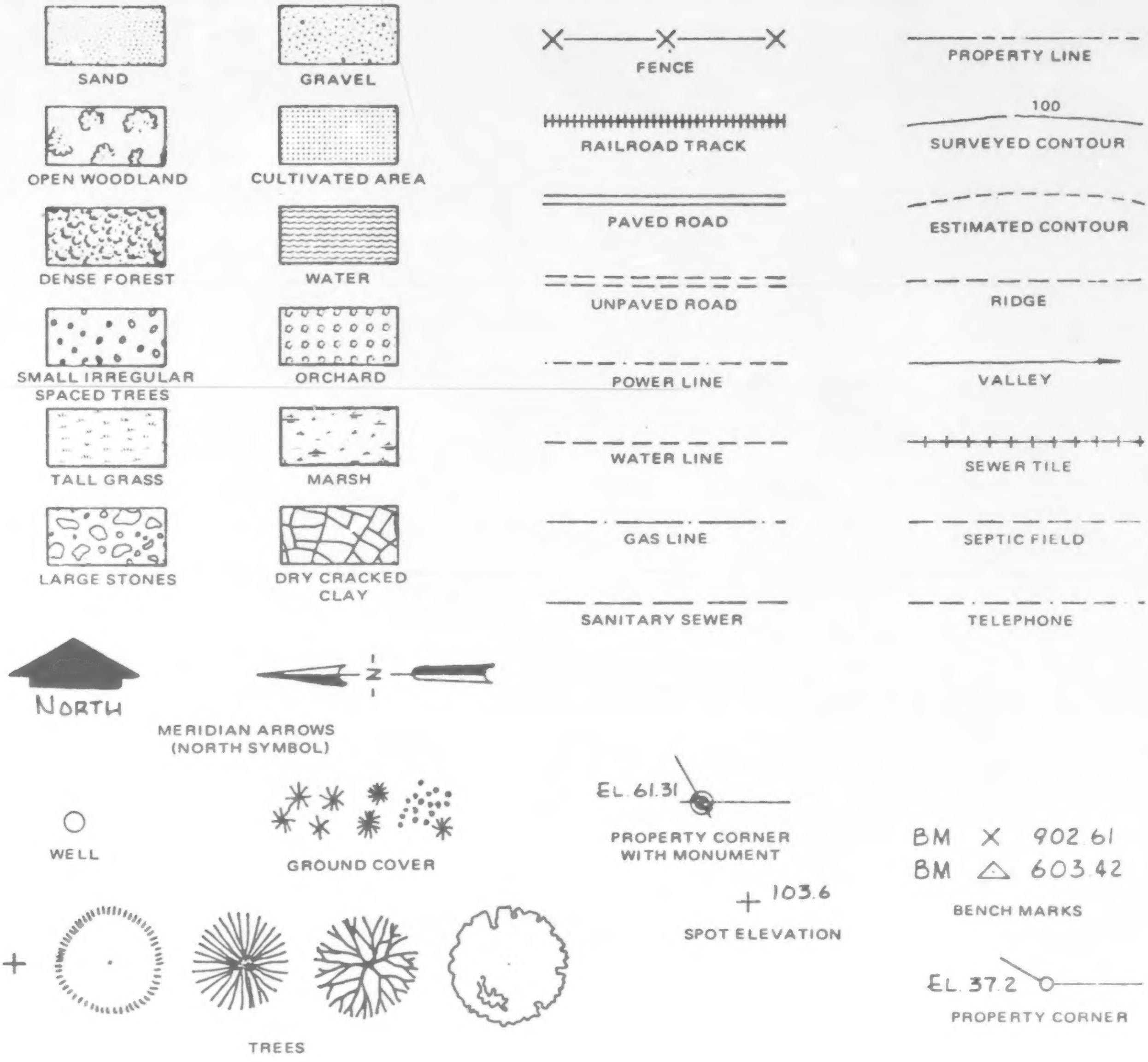


COURTESY OF
GOODHEART-WILLCOX CO. INC.
ARCHITECTURE AND RESIDENTIAL
DESIGN

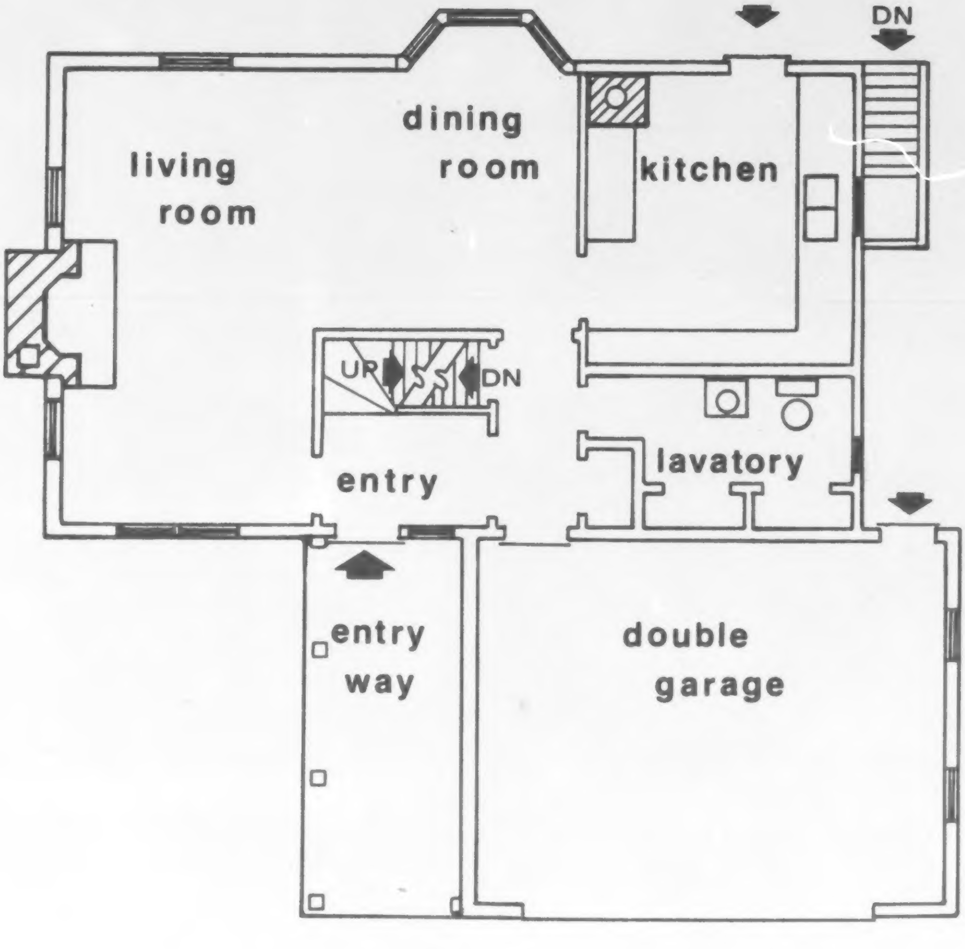
SCALE: 1" = 30'-0"

1.6.0 - TM 2

# TOPOGRAPHICAL SYMBOLS



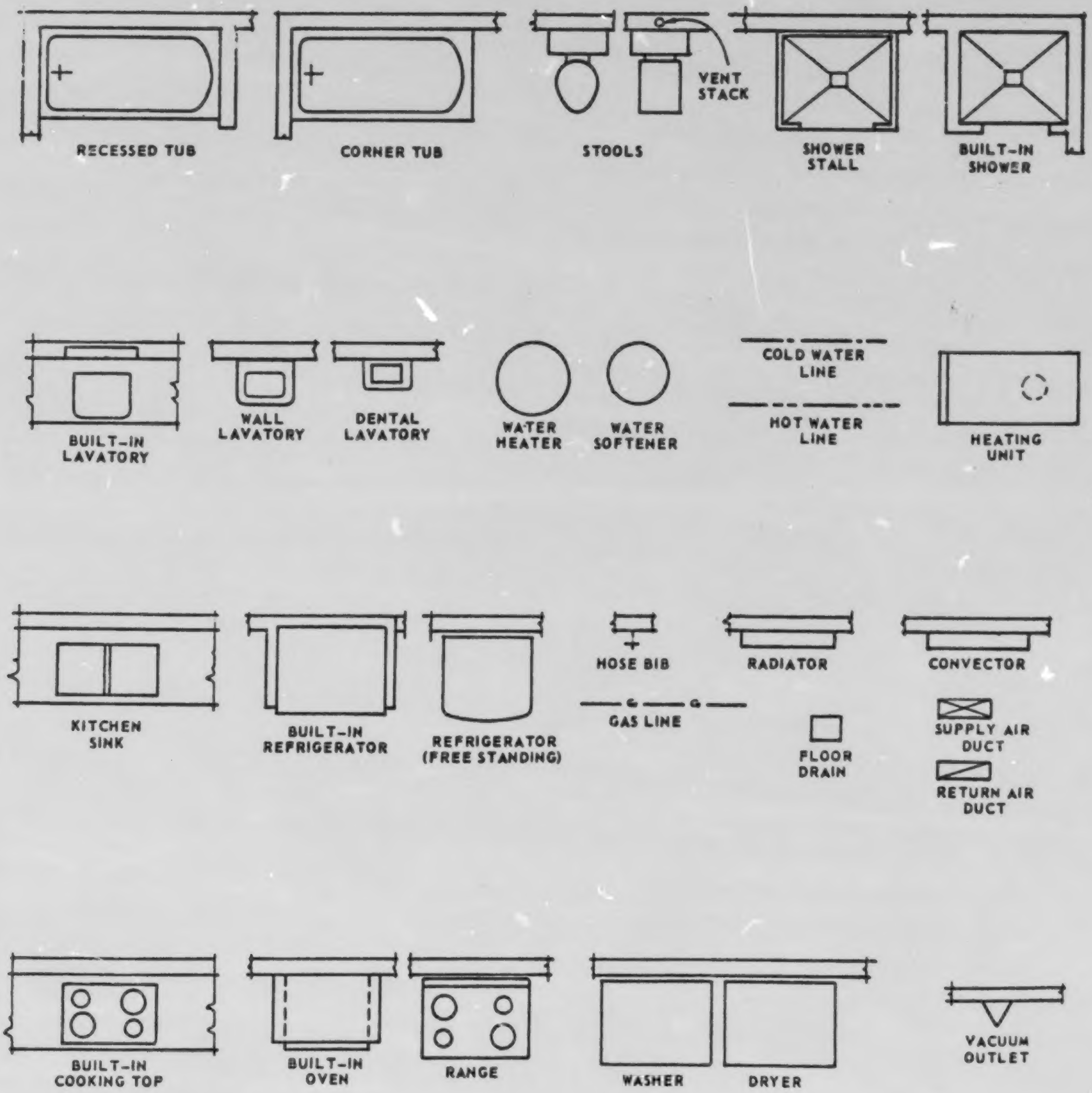
COURTESY OF
GOODHEART-WILLCOX CO. INC.
ARCHITECTURE RESIDENTIAL DRAWING
AND DESIGN



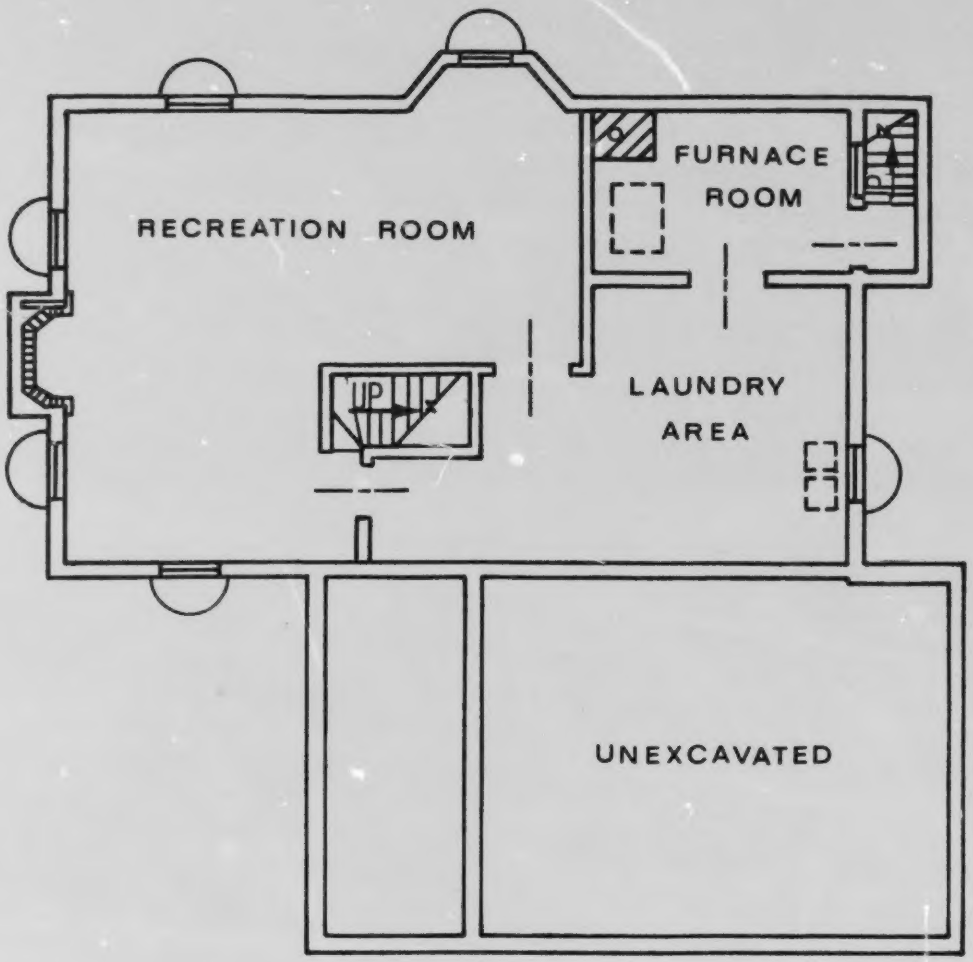
# FIRST FLOOR

COURTESY OF
AMERICAN TECHNICAL SOCIETY
DURBAHN AND SUNDBERG, FUNDAMENTALS OF CARPENTRY
VOLUME 2, 4TH EDITION

# FLOOR PLAN SYMBOLS



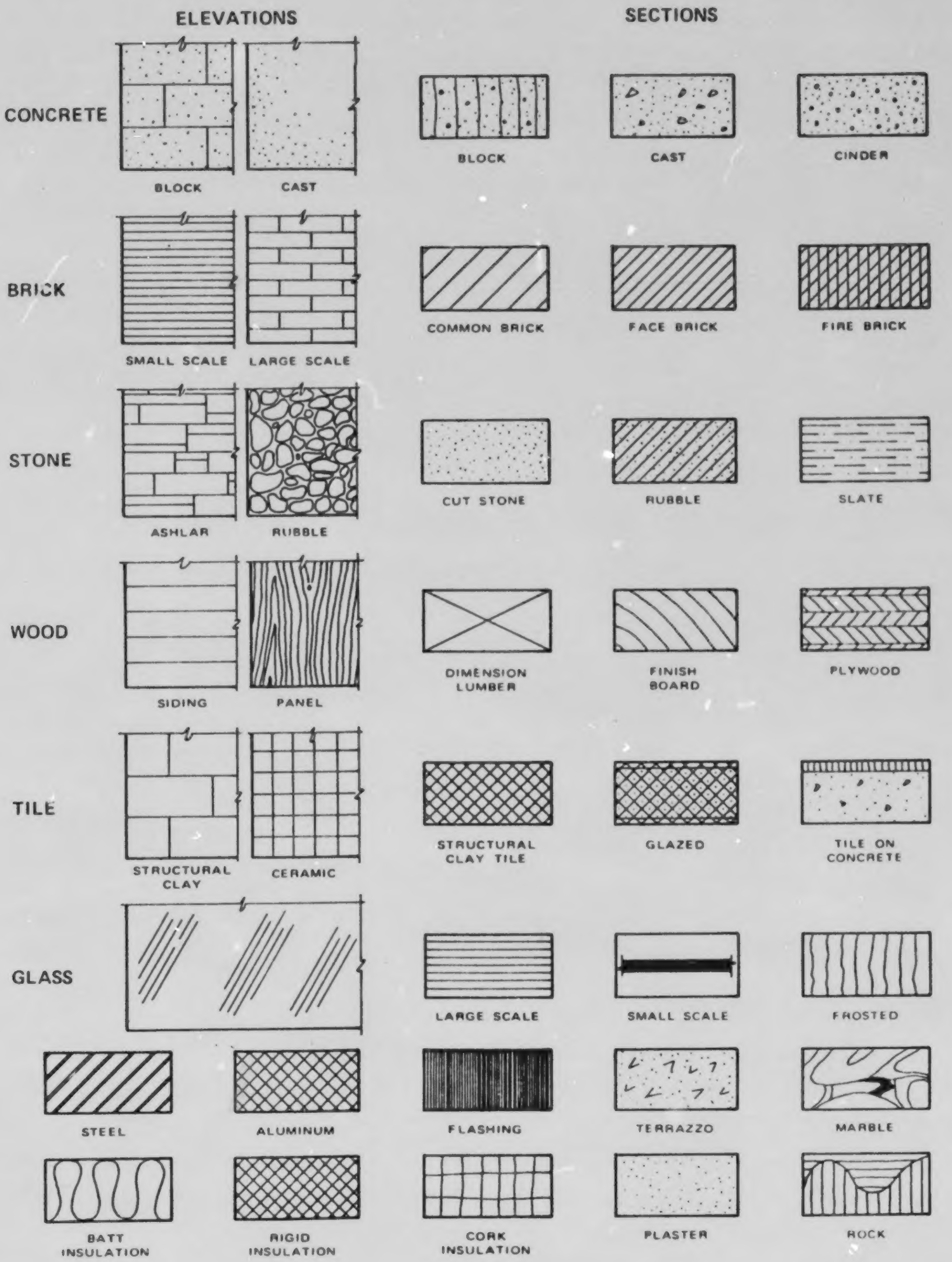
COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY
IML-UMC

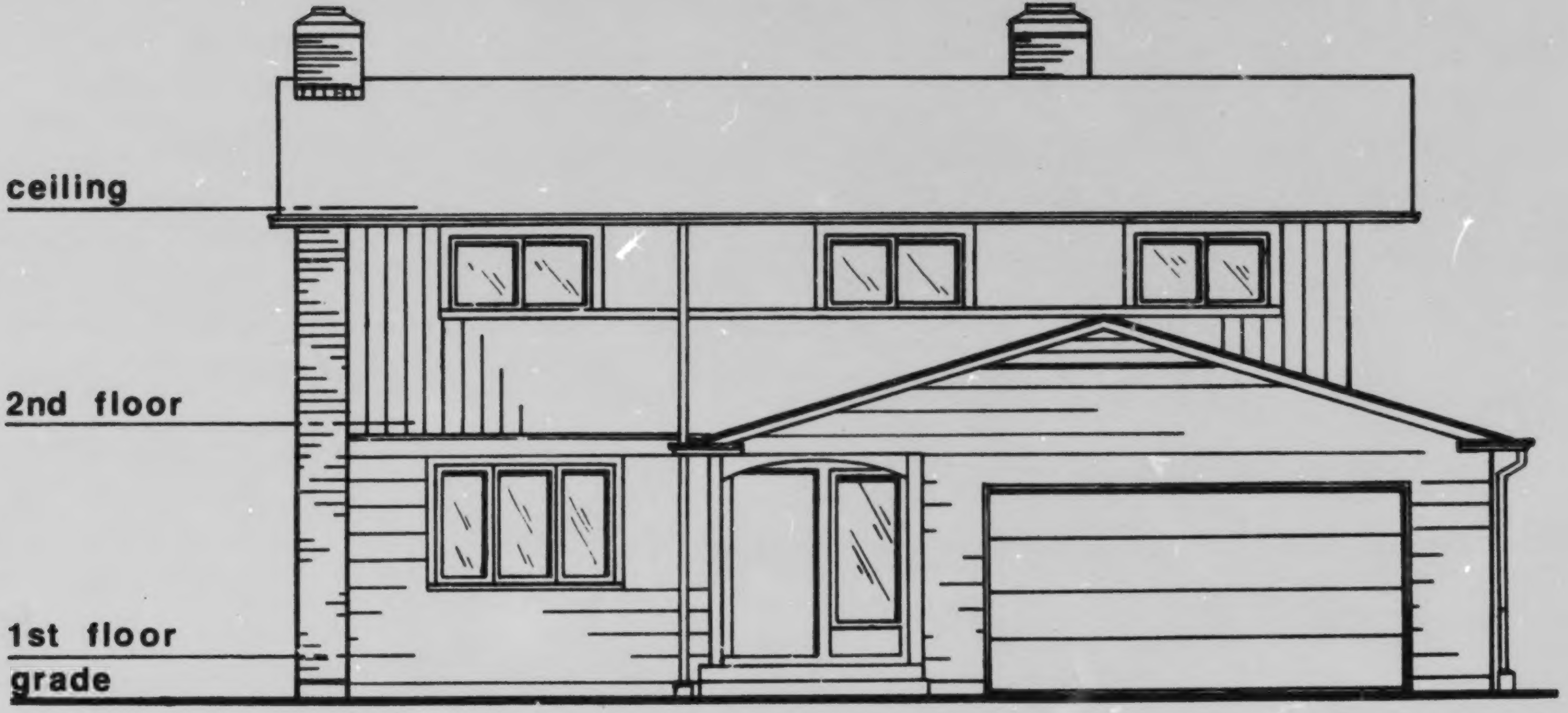


## BASEMENT

FUNDAMENTALS OF CARPENTRY
4TH EDITION, FIG.3, PAGE 7
AMERICAN TECHNICAL SOCIETY
IML UMC

# MATERIAL SYMBOLS





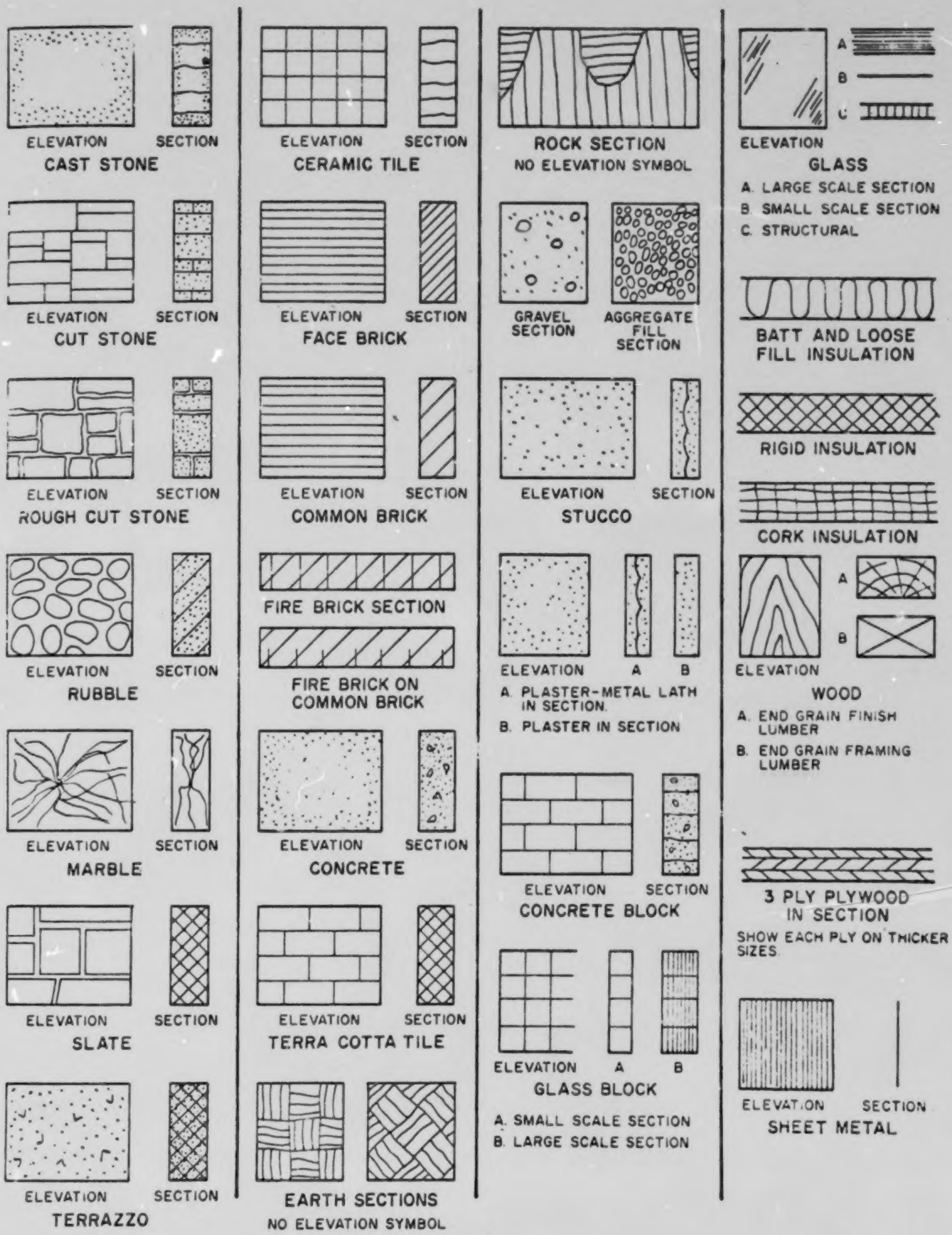
FRONT ELEVATION no scale

1.6.0 - TM 8

COURTESY OF
DURBAHN AND SUNDBERG, FUNDAMENTALS OF CARPENTRY
VOLUME 2, 4TH EDITION
AMERICAN TECHNICAL SOCIETY

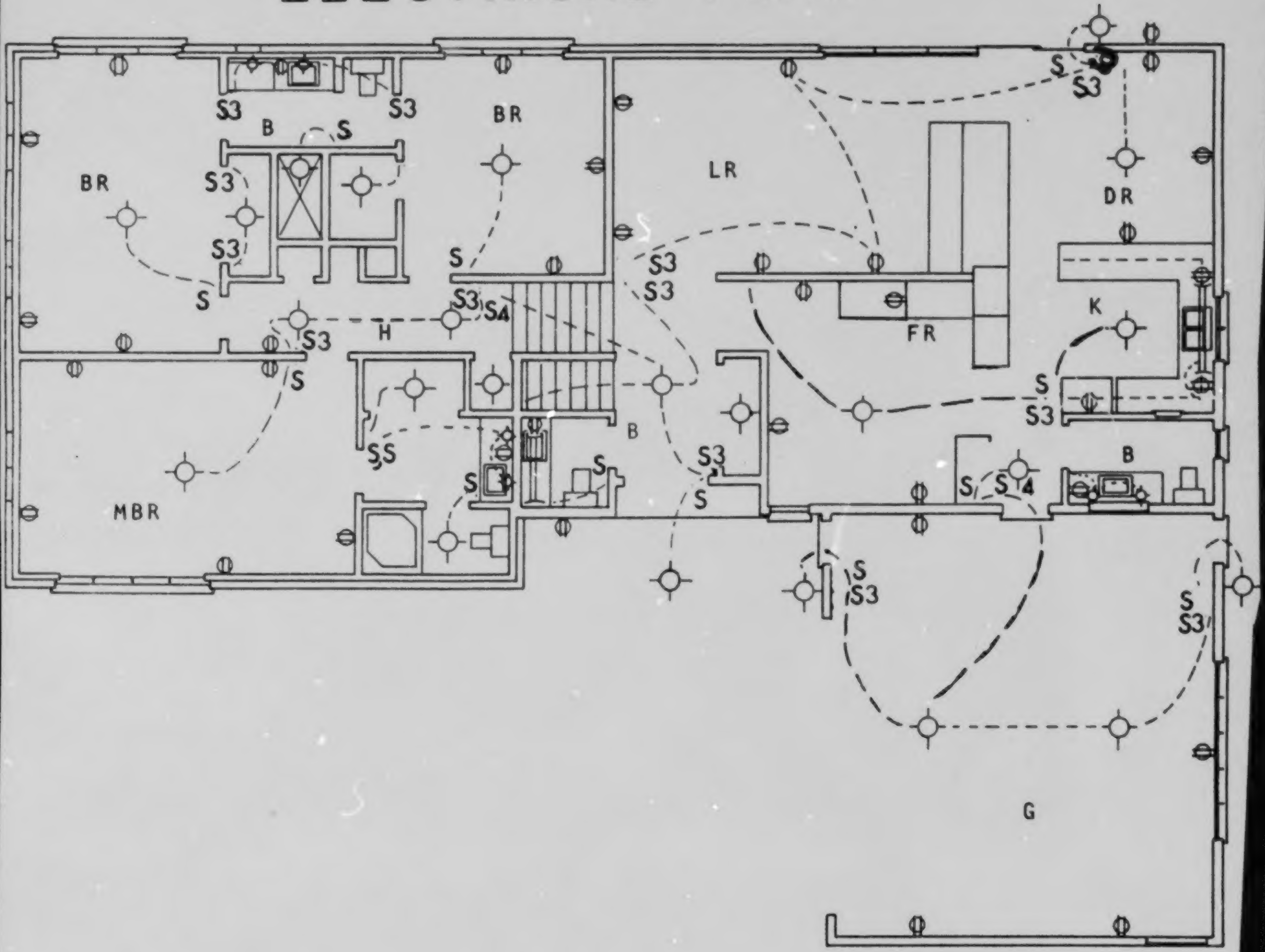
IML-UMC

# ELEVATION SYMBOLS

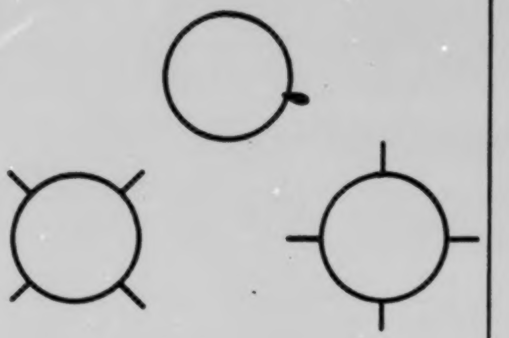


COURTESY OF
MCKNIGHT & MCKNIGHT
ARCHITECTURE
IML-UMC

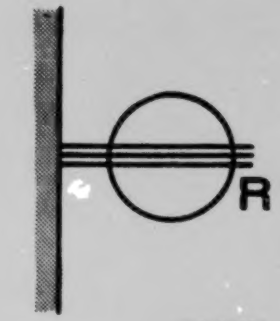
# ELECTRICAL PLAN



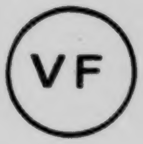
# ELECTRICAL SYMBOLS



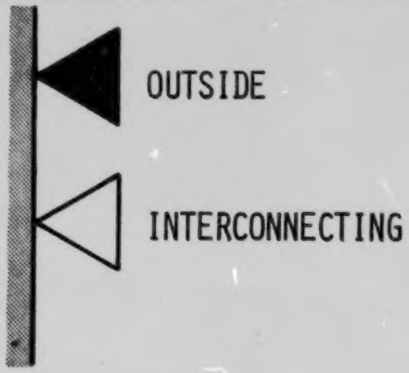
CEILING FIXTURE
OUTLETS



RANGE
OUTLET

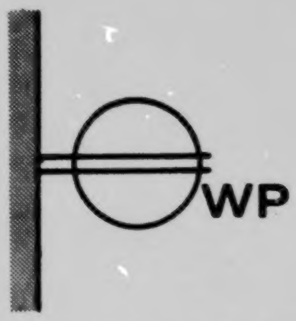


VENTILATING
FAN

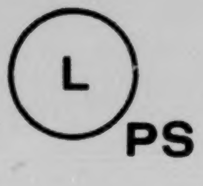


TELEPHONE

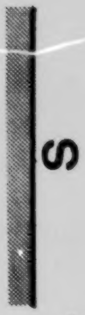
# ELECTRICAL SYMBOLS



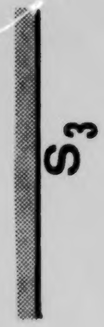
WEATHERPROOF
OUTLET



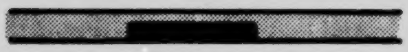
LAMP HOLDER WITH
PULL SWITCH



SINGLE POLE
SWITCH

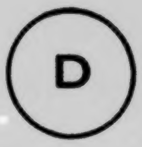


THREE-WAY
SWITCH

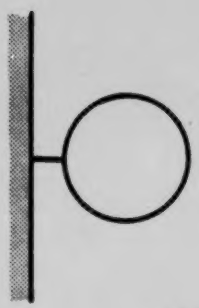


LIGHTING PANEL

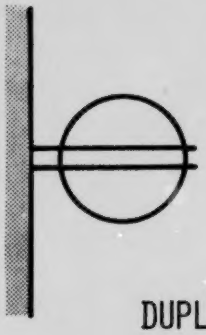
# ELECTRICAL SYMBOLS



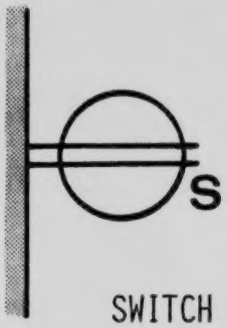
DROP
CORD



WALL
BRACKET

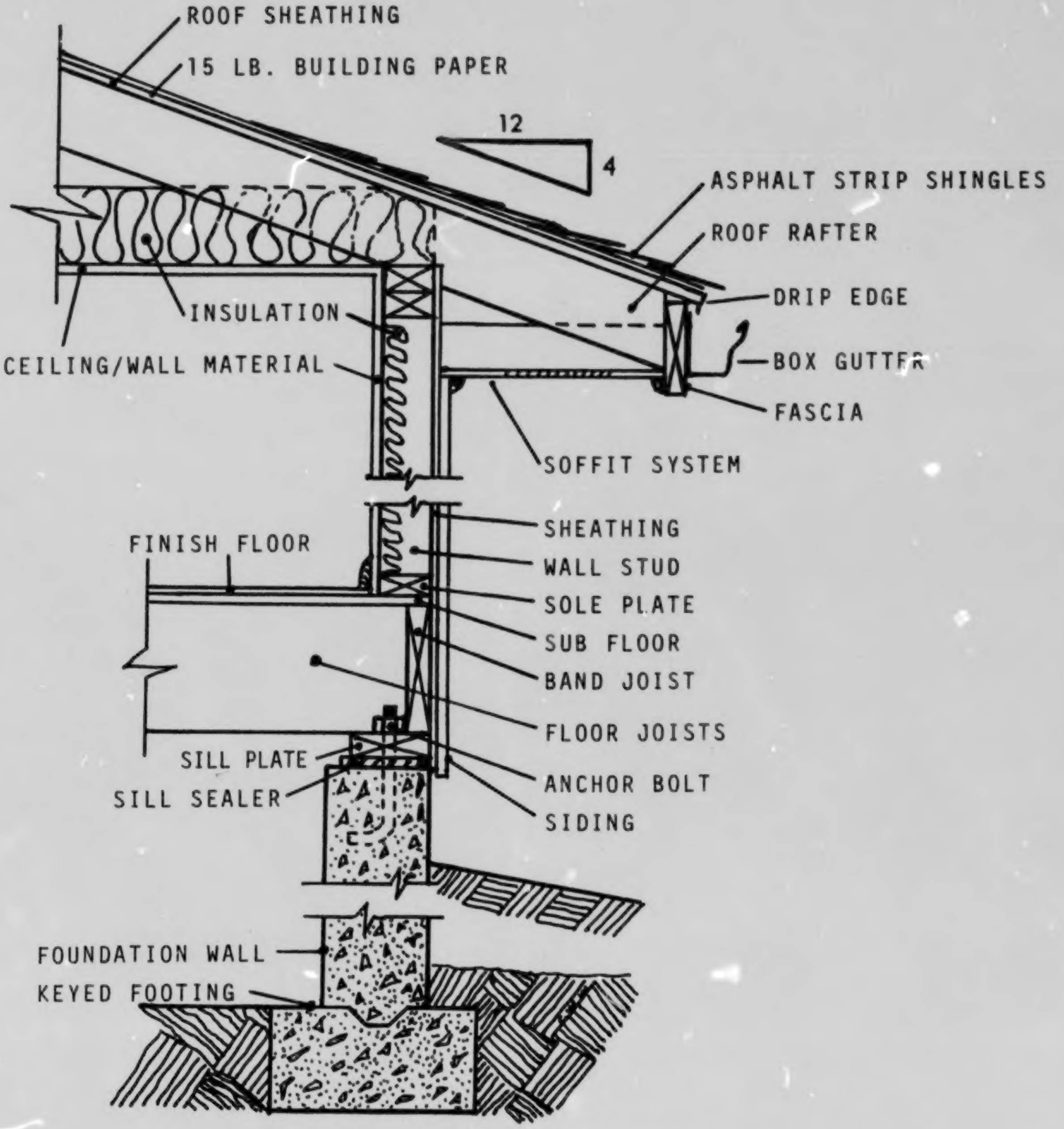


DUPLEX
CONVENIENCE
OUTLET

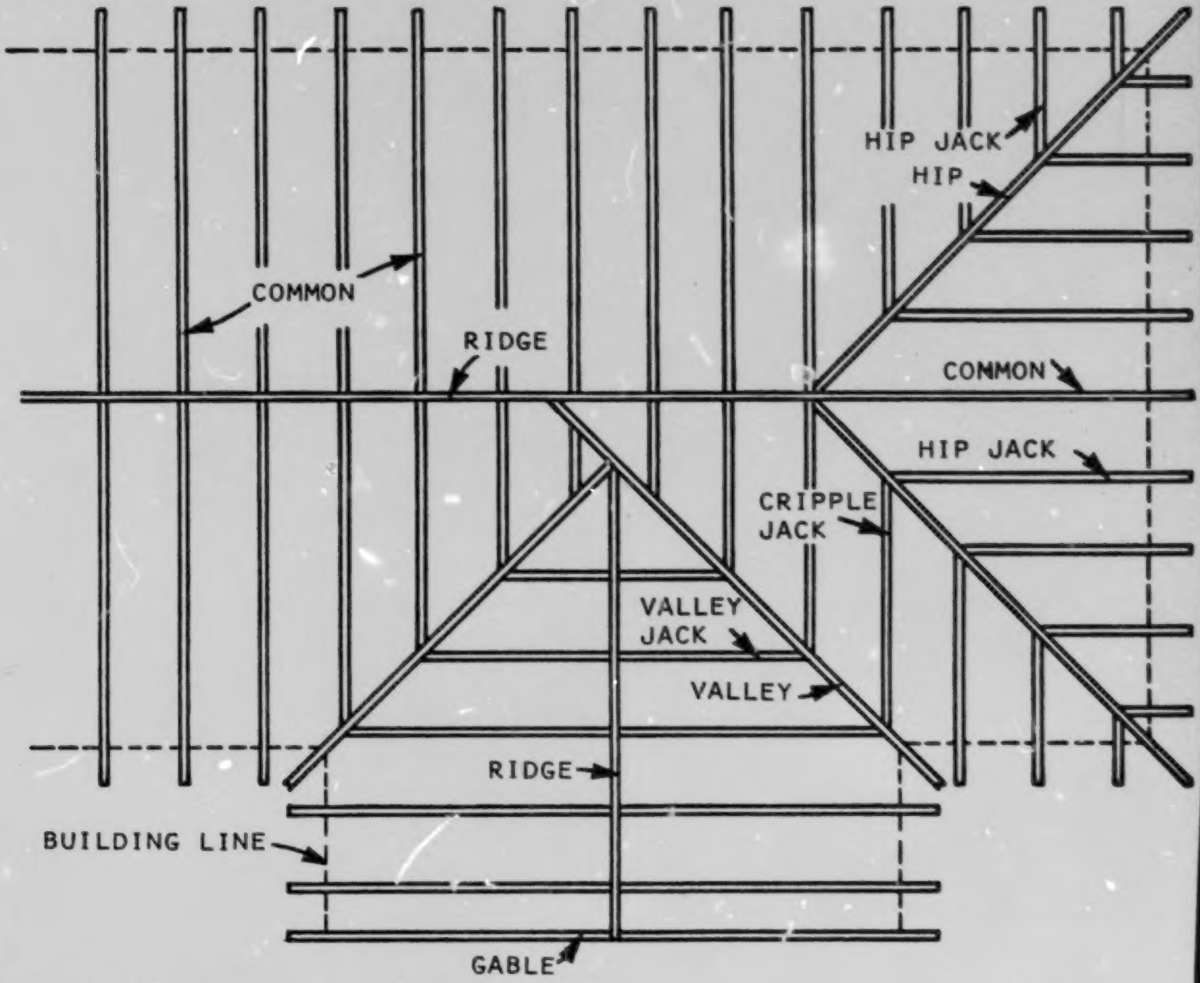


SWITCH AND
CONVENIENCE
OUTLET

# WALL SECTION



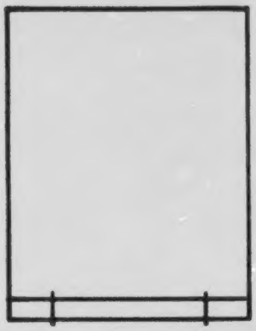
# PLAN VIEWS OF ROOF FRAMES



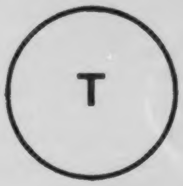
1.6.0 - TM 15

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS WAGNER
IML-UMC

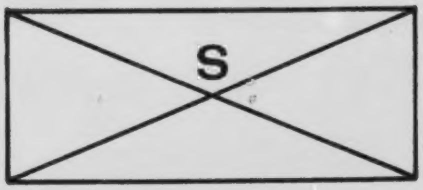
# HEATING SYMBOLS



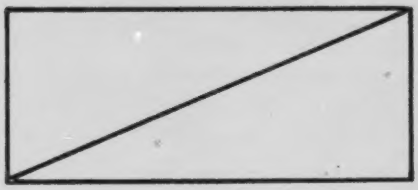
HEATING UNIT



THERMOSTAT

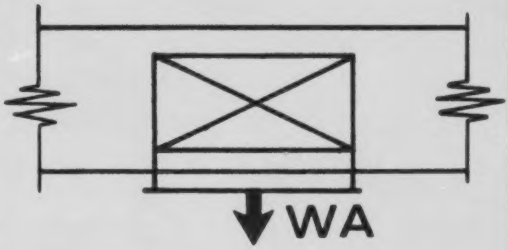


SUPPLY DUCT

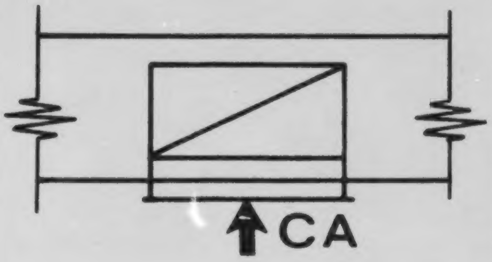


EXHAUST DUCT

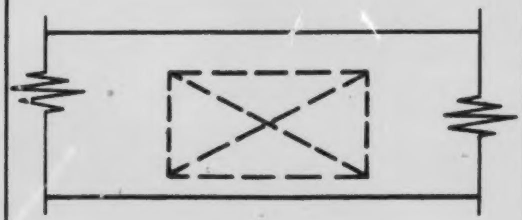
# HEATING SYMBOLS



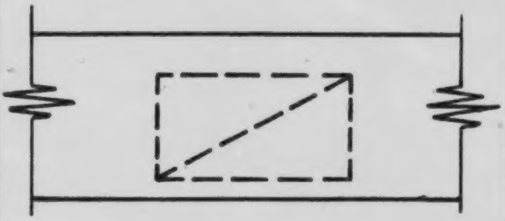
WARM AIR SUPPLY



COLD AIR RETURN



SECOND FLOOR
SUPPLY



SECOND FLOOR
RETURN

## PREPARING WORKING DRAWINGS
## SECTION 1.6.0

### ASSIGNMENT SHEET #1 - READING WORKING DRAWINGS

After studying the information in the references, match each item in the right-hand column with the correct description in the left-hand column.

______1. Plans showing the structure components of a building.

______2. An arbitrary sign that has been standardized and is used to represent an object, quality, material or method.

______3. Plans showing the heating and plumbing layout.

______4. A drawing that gives complete detailed information for an element of construction.

______5. A set of widely used symbols covering all the lines needed to show the shape and size of an object.

______6. A drawing of an object that has been cut away to show internal construction features.

______7. A graphic representation developed with the use of lines and symbols.

______8. The arrangement of lines and symbols to show the actual size of constructing the object.

______9. A drawing showing a horizontal view of structures such as floor plans.

______10. Drawing representing the front, sides or rear of a residential structure.

a. Architectural drawings

b. Section

c. Alphabet of lines

d. Detail

e. Dimensions

f. Elevation

g. Plan

h. Symbol

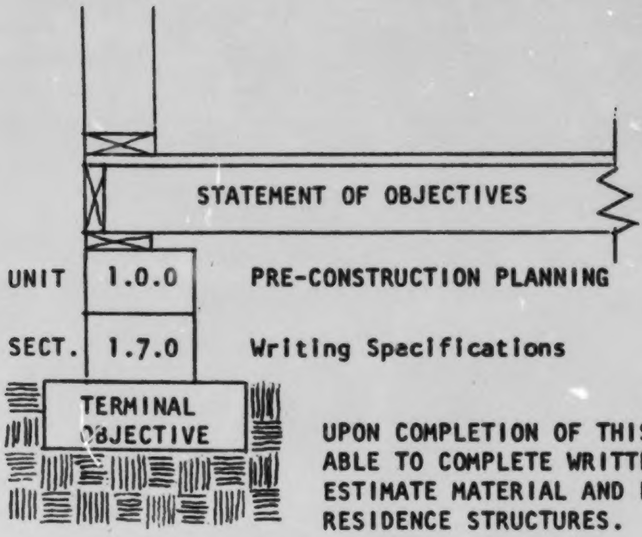
i. Mechanical drawing

j. Structural drawing

## PREPARING WORKING DRAWINGS
## SECTION 1.6.0

### ANSWERS TO ASSIGNMENT #1

1. j
2. h
3. i
4. d
5. c
6. b
7. a
8. e
9. g
10. f



## STATEMENT OF OBJECTIVES

**UNIT** 1.0.0 **PRE-CONSTRUCTION PLANNING**

**SECT.** 1.7.0 **Writing Specifications**

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL BE ABLE TO COMPLETE WRITTEN SPECIFICATION FORMS AND ESTIMATE MATERIAL AND LABOR COSTS FOR SINGLE FAMILY RESIDENCE STRUCTURES.

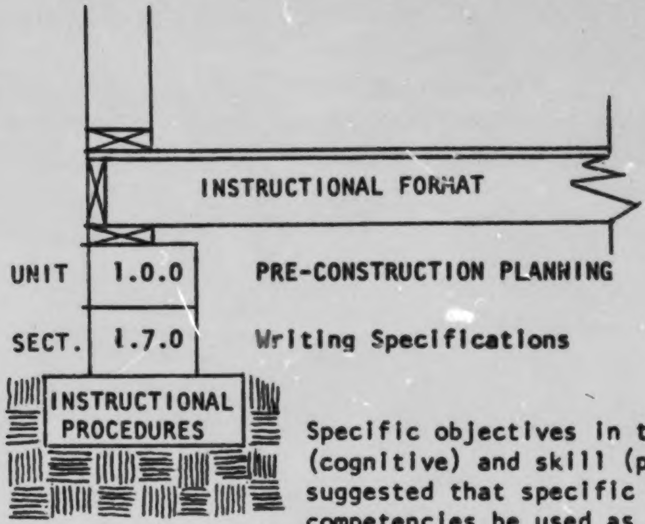
### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

1.7.1 Write the specifications for the construction of a single family residence using the most recent standard Veterans Administration form 26-1852 or Federal Housing Administration form 2005.

1.7.2 Calculate the labor and material cost for a single family residential structure in your locality. Use a standard printed form for estimating.

NOTE: SEE "TAKE OFF" GUIDE.



UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.7.0 Writing Specifications

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local architectual firms, lending institutions, reputable contractor or attorney for supplemental information related to writing specifications and preparing material and labor estimates.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Assignment sheet #1 - Reading Drawings and Specifications
- D. Answers to assignment sheet #1
- E. Assignment sheet #2 - Estimating Cost of Residential Structure
- F. Answers to assignment sheet #2

IV. References:

- A. Kicklighter, Clois E. and Ronald J. Baird. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.
- B. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.
- C. Spence, William P. Architecture Design Engineering Drawing. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

## WRITING SPECIFICATIONS
## SECTION 1.7.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Construction specifications

A. Definition

B. Purpose

II. Written specification categories

A. Legal provisions

1. Documents used in advertisements for bids

2. Bond forms and owner/contractor agreements

B. General provisions

1. Definition

2. Model sets

3. Coverage (not covered elsewhere)

C. Technical provisions

1. Definitions (kinds of materials and processes)

2. Formats

a. American Institute of Architects

b. Veterans Administration Form 26-1852

c. Federal Housing Administration Form 2005

d. Federal Savings and Loan Form 45809-1

e. USDA-FHA Form FHA 424-2

3. Arrangement of information

4. Information generally included

a. Description of materials

b. List of operations under major headings

c. Cash allowance details

d. Statement clarifying relationship of specifications to working drawings

e. Quality of workmanship statement

f. Contractor liability during construction

III. Estimating building costs

A. Estimating definition

B. Preliminary estimates

1. Square foot method

a. Area calculations

b. Areas included

c. Establishing constant multiplier

d. Land

e. Style

f. Special features

2. Cubic foot method

a. Volume calculations

b. Space areas included

c. Establishing constant multiplier

C. More accurate estimates

1. List materials and cost

2. Labor costs

a. Percentage of total cost

        - b. Sources of costs
            - 1. Building construction cost data book
            - 2. General construction
            - 3. Sub-contractors
            - 4. Lending institutions
    - 3. Permit fees
        - a. Building
        - b. Plumbing
        - c. Electrical
        - d. Health
        - e. Utility service connection
    - 4. Liability insurance
- D. Summary
    - 1. Accuracy
    - 2. Drawings and specifications

# WRITING SPECIFICATIONS
## SECTION 1.7.0

## ASSIGNMENT SHEET #1 - READING DRAWINGS AND SPECIFICATIONS

After studying the information in the references, match each item in the right-hand column with the correct description in the left-hand column.

______1. Slope of the garage floor

______2. Concrete mix for footings

______3. Model number of both shower units

______4. Floor and ceiling joist size

______5. Datum level

______6. Sub-floor direction

______7. Precise location of electrical outlets

______8. Color and type of exterior wall finish

______9. Type of roof shingles

_____10. Type of lighting fixtures

a. Only on working drawings

b. Only in specifications

c. Both in specifications and on working drawings

# WRITING SPECIFICATIONS
## SECTION 1.7.0

## ASSIGNMENT SHEET #2 - ESTIMATING COST OF RESIDENTIAL STRUCTURE

After studying the information in the references, estimate the total cost of a one-level single family residential structure. Use the information provided below. Building cost shall be calculated at $35.00 per square foot for living space. Lot cost is estimated at $10,000.00.

| ITEM | AREA (Sq. ft.) | COST PER (Sq. Ft.) | SUB TOTALS |
|---|---|---|---|
| Living area | 1800 | a.________ | d.__________ |
| Garage area | 576 | b.________ | e.__________ |
| Porch area | 120 | c.________ | f.__________ |
| Lot | | | g.__________ |
| TOTAL ESTIMATED COST OF STRUCTURE | | | h.__________ |

## WRITING SPECIFICATIONS
## SECTION 1.7.0

### ANSWERS TO ASSIGNMENT #1

1. a
2. b
3. a
4. c
5. a
6. a
7. a
8. b
9. c
10. b

# WRITING SPECIFICATIONS
## SECTION 1.7.0

## ANSWERS TO ASSIGNMENT #2

| | |
|---|---|
| a. | $35.00 |
| b. | $17.50 |
| c. | $17.50 |
| d. | $63,000.00 |
| e. | $10,000.00 |
| f. | $ 2,100.00 |
| g. | $10,000.00 |
| h. | $85,180.00 |

# STATEMENT OF OBJECTIVES

UNIT 1.0.0 PRE-CONSTRUCTION PLANNING

SECT. 1.8.0 Financing and Contracting

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL BE INFORMED ABOUT THE TYPES OF MORTGAGE LOANS GENERALLY ABAILABLE FOR RESIDENTIAL CONSTRUCTION AND THE TYPES OF WRITTEN CONTRACTS THAT USUALLY ACCOMPANY CONTRACTUAL ARRANGEMENTS BEWTEEN THE PROSPECTIVE OWNER AND THE CONTRACTOR OR BUSINESS FIRM.

## SPECIFIC OBJECTIVES

After completion of this section, the learner will:

1.8.1 List in writing the types of mortgage loans available for single family construction, the interest rate for each type loan, the percentage of down payment required for each type of loan, and the total repayment amount from an amortization schedule for twenty, twenty-five, and thirty year loans. Request an amount of money to pay for the construction of a single family residence you or your class is planning.

1.8.2 Contracts to build a single family residence are generally written arrangements between the owner and the firm/business individual providing the construction services. List in writing three (3) of the most common contractual arrangements and a minimum of three (3) characteristics of each method of contracting.

1.8.3 Identify three (3) kinds of mortgages that can be obtained under approved state laws for the purpose of financing the construction of a single family residence. Draw a table which will compare the characteristics of each kind of mortgage.

## INSTRUCTIONAL FORMAT

UNIT 1.0.0 **PRE-CONSTRUCTION PLANNING**

SECT. 1.8.0 **Financing and Contracting**

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local lending institutions and law firms for supplemental information related to financing and contracting the building of residential structure.

III. Instructional materials used in this section:

A. Statement of objective sheet

B. Information sheet

C. Transparency masters

   1. TM 1 - Construction Agreement (part 1)

   2. TM 2 - Construction Agreement (part 2)

D. Assignment sheet #1 - Financing the Construction Project

E. Answers to assignment sheet #1

IV. References:

A. Kicklighter, Clois E. and Ronald J. Baird. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.

B. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

C. Spence, William P. Architecture Design Engineering Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# FINANCING AND CONTRACTING
## SECTION 1.8.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Types of mortgage contracts
    A. Government insured loaning agencies
        1. FHA (Federal Housing Administration currently under HUD)
        2. VA Veterans Administration G.I. Loans
        3. Purpose
        4. Function
        5. Provisions
            a. Interest rates
            b. Construction specifications
    B. Conventional loan types
        1. Savings and loan associations
        2. Mortgage companies
        3. Banks
        4. Insurance companies
        5. Individuals
        6. Characteristics
            a. Interest cost
            b. Insurability
    C. Land contract loans
        1. Owner-buyer agreement
        2. Interest rates
        3. Purchase price
        4. Contract

II. Types of contractual arrangements

A. Owner-architect

1. Written duties

a. Preliminary plans

b. Estimate of cost

c. Working drawings and specifications

d. Contractor selection

e. Contract between owner and contractor

f. House design

g. Site supervision

2. Method of payment

3. Construction responsibilities by owner

B. Owner-architect (owner supervises construction)

1. Architect responsibilities

a. Contract to build signature ends relationship

b. Optional arrangements

1. Limited architect assistance

2. Plan and specification responsibilities

3. Final check and payment order

2. Owner responsibilities

a. Easements

b. Lot boundaries

c. Utilities

d. Street information

C. Owner-contractor

  1. Contractor responsibilities

    a. Materials

    b. Quality of workmanship

  2. Owner responsibilities

    a. Light fixtures

    b. Hardware

    c. Bath fixtures

    d. Payment of contractor

    e. Owner work contract

# CONSTRUCTION AGREEMENT
(PART 1)

GENERAL TYPE OF WORK: ELECTRICAL

ADDRESS OF BUILDING SITE:

NAME: ____________________

HOUSE SIZE: ____________________

BUYER: ____________________ WHOSE ADDRESS IS: ____________________

____________________, IS DESIROUS OF HAVING SERVICES PERFORMED AND/OR MATERIALS FURNISHED, AS DESCRIBED HEREIN, FOR A CERTAIN BUILDING TO BE CONSTRUCTED ON THE ABOVE SITE, AND....CONTRACTOR,..............., WHOSE ADDRESS IS:......................... ......................................., IS DESIROUS OF CONTRACTING FOR SAID SERVICES AND/OR MATERIALS,

THEREFORE, IT IS MUTUALLY AGREED BETWEEN BUYER AND CONTRACTOR AS FOLLOWS

1. THE CONTRACTOR AGREES TO PERFORM WORK AND/OR TO FURNISH MATERIALS, ALL IN ACCORDANCE WITH THE FOLLOWING SPECIFICATIONS: (NOTE: SPECIFICATIONS MUST BE DETAILED. ATTACH ADDITIONAL SHEETS IF NECESSARY.)

PLAN NO. (ONLY ITEMS CHECKED, INDICATE WORK TO BE PERFORMED BY CONTRACTOR.)

( ) 100 AMP SVC ( ) 200 AMP SVC

( ) ............110V OPGS (SWITCHES, OUTLETS, LIGHT BOXES, WIRE OPG)

( ) ...........220V OPGS

( ) WIRE FOR DOORBELL (CHIMES NOT INCLUDED.)
SWITCHES, RECEPTACLES, PLATES TO BE IVORY FINISH, "QUIET" TYPE.

( ) ...........8" BATH VERTICLE VENT FANS-TYPE #..................

( ) ...........LIN. FT. DIRECT BURIAL WIRE ( ) 110V ( ) 220V

( ) PROVIDE WIRE AND JUNCTION BOX FOR FURNACE.

NOTE: CONTRACTOR AGREES TO HOOK UP OVEN, RANGE HOOD, ALL LIGHTS, FANS AND WATERHEATER.
CONTRACTOR WILL COMPLY WITH ALL ELECTRICAL CODES.
ALL LIGHT FIXTURES TO BE FURNISHED BY OWNER. OWNER TO HAVE LIGHT FIXTURES ON JOB AT TIME SPECIFIED BY CONTRACTOR.

NOTE: CONTRACTOR DOES NOT INCLUDE LABOR OR MATERIAL BEYOND ELECTRICAL ENTRANCE.

1.8.0 - TM 1

## CONSTRUCTION AGREEMENT
## (PART 2)

THIS CONTRACT COVERS:

( ) LABOR ONLY ( ) MATERIAL ONLY ( ) LABOR AND MATERIAL ONLY

2. THE SUM TO BE PAID BY THE BUYER TO THE CONTRACTOR FOR THE PERFORMANCE OF THIS CONTRACT IS $______________________

3. THE CONTRACTOR WILL PERFORM ACCORDING TO THE TERMS OF THIS CONTRACT AS EXPEDIENTLY AS IS POSSIBLE, WITH A REASONABLE ALLOWANCE FOR ADVERSE WEATHER CONDITIONS.

4. THE CONTRACTOR WILL MAINTAIN LIABILITY AND PROPERTY DAMAGE, INSURANCE COVERAGE WHILE THIS CONTRACT IS BEING PERFORMED AND HOLD THE BUYER HARMLESS FROM LIABILITY CLAIMS THAT MAY ARISE IN CONNECTION WITH THE CONSTRUCTION HEREIN DESCRIBED.

5. THE CONTRACTOR WILL PROPERLY INSURE ALL WORKMEN ACCORDING TO THE WORKMEN'S COMPENSATION LAWS AND OTHER STATUES OF THE STATE IN WHICH CONSTRUCTION IS BEING PERFORMED DURING THE PERIOD OF THIS CONTRACT, AND CONTRACTOR WILL, IF REQUESTED BY THE BUYER, FURNISH CERTIFICATES OF INSURANCE COVERAGE.

6. CONTRACTOR WILL WARRANT ALL WORKMANSHIP AND MATERIALS FURNISHED IN PERFORMANCE OF THIS CONTRACT AND SETTLE PROPTLY, AT HIS EXPENSE, AND CLAIM ARISING DUE TO QUALITY OF WORKMANSHIP OR MATERIALS, AND BUYER AGREES TO LOOK SOLELY TO CONTRACTOR FOR SETTLEMENT OF ANY SUCH CLAIMS.

7. THE CONTRACTOR WILL, AT TIME OF FINAL PAYMENT, FURNISH THE BUYER WITH A WAIVER OF LIEN IN A FORM SATISFACTORY TO THE BUYER, CERTIFYING THAT ALL LABOR AND/OR MATERIALS FURNISHED UNDER THIS CONTRACT HAVE BEEN PAID IN FULL.

8. IN THE EVENT THE CONTRACTOR FAILS TO PERFORM ACCORDING TO ANY OF THE COVENANTS HEREIN WITHIN A REASONABLE PERIOD OF TIME, THE BUYER MAY NOTIFY THE CONTRACTOR AND TAKE OVER AND COMPLETE THIS CONTRACT AND DEDUCT ALL COSTS SO INCURRED BY THE BUYER FROM THE AMOUNT OTHERWISE DUE THE CONTRACTOR HEREUNDER.

DATE____________________,19________

______________________________ ______________________________
(BUYER) (CONTRACTOR)

BY____________________________ ______________________________
(SIGNATURE) (SIGNATURE)

## ASSIGNMENT SHEET #1 - FINANCING THE CONSTRUCTION PROJECT

From a local bank or a home finance agency, ascertain the following information concerning a $40,000.00 house loan and a down payment requirement of 25% for conventional loans, 20% for FHA loans and 10% for VA loans.

| TYPE OF LOAN | LENGTH OF LOAN | INTEREST RATE | MONTHLY PAYMENT | DOWN PAYMENT | NO.OF MONTHS | TOTAL REPAY | INTEREST PAID |
|---|---|---|---|---|---|---|---|
| Conventional | 20 yrs. | 10% | 386.01 | a.______ | d.______ | g.______ | j.______ |
| FHA | 25 yrs. | 9% | 335.68 | b.______ | e.______ | h.______ | k.______ |
| VA | 30 yrs. | 8% | 293.51 | c.______ | f.______ | i.______ | l.______ |

# FINANCING AND CONTRACTING
## SECTION 1.8.0

## ANSWERS TO ASSIGNMENT #1

a. $10,000.00

b. $ 8,000.00

c. $ 4,000.00

d. 240

e. 300

f. 360

g. $ 88,322.40

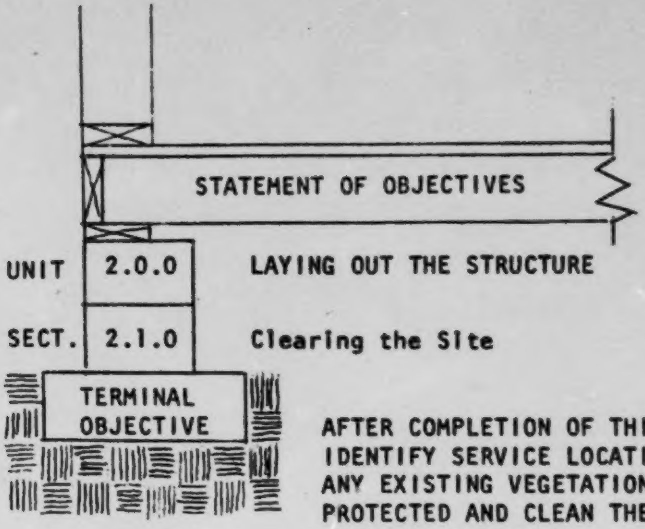
h. $100,704.00

i. $105,663.60

j. $ 48,322.40

k. $ 60,704.00

l. $ 65,663.60



## STATEMENT OF OBJECTIVES

UNIT 2.0.0 LAYING OUT THE STRUCTURE

SECT. 2.1.0 Clearing the Site

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL IDENTIFY SERVICE LOCATIONS FROM A PLOT PLAN, LOCATE ANY EXISTING VEGETATION OR STRUCTURES ON A SITE TO BE PROTECTED AND CLEAN THE SITE BY CHOOSING THE APPROPRIATE CLEANING PRACTICES.

### SPECIFIC OBJECTIVES

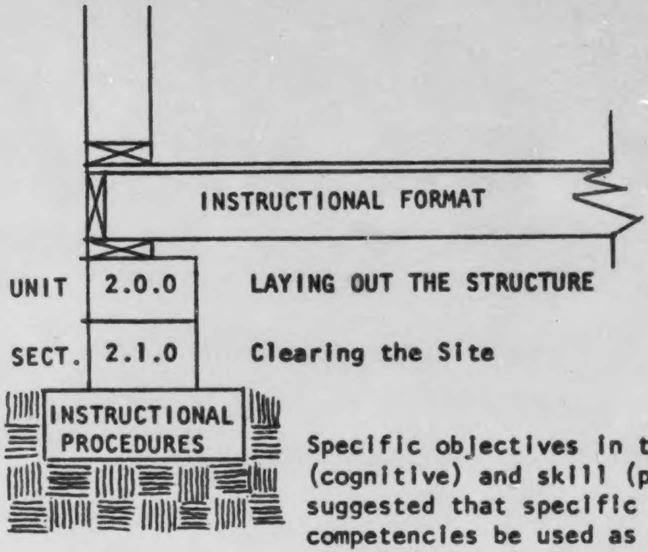
After completion of this section the learner will:

2.1.1 Select and make provisions for protecting vegetation/structures to be retained according to written specifications and information on the architectural drawings.

2.1.2 Clear the site to accommodate the new structure.

2.1.3 Locate existing sub-grade service installations and protect from damage by location identification.

2.1.4 Write at least four of the most common site clearing practices.



## INSTRUCTIONAL FORMAT

UNIT 2.0.0 **LAYING OUT THE STRUCTURE**

SECT. 2.1.0 **Clearing the Site**

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local utility companies for information on ascertaining the location of sub-grade utility installations. (Gas, electricity, water, sewer, field tile, etc.). Equipment operators from local construction firms to assist in the explanation of common site clearing practices involving heavy earth moving equipment.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Assignment sheet #1 - Site Clearing Methods and Equipment
- D. Answers to assignment sheet #1

IV. References:

- A. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.
- B. Lux, Donald G. and Willis E. Ray, Co-Directors. The World of Construction. 4th. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1970.

# CLEARING THE SITE
## SECTION 2.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Site factors

   A. Definition

   B. Factors

      1. Size

      2. Natural growth

      3. Natural obstacles

      4. Man-made obstacles

II. Common site clearing practices

   A. Demolishing

      1. Blasting

      2. Wrecking

   B. Salvaging

   C. Cutting

   D. Burning

   E. Earthmoving

   F. Disposing

## CLEARING THE SITE
## SECTION 2.1.0

### ASSIGNMENT SHEET #1 - SITE CLEARING METHODS AND EQUIPMENT

After studying the information in the references, match each item in the right-hand column with the correct description in the left-hand column.

______1. Demolition using bulldozer.

______2. May be achieved by burning, or hauling away.

______3. Saving items from destruction.

______4. Use of axes, torches or saws.

______5. Efficient way to destroy wood and vegetation.

______6. In addition to clearing, serves as a major part of construction project, such as dams.

______7. Demolition using high explosives.

______8. Usually used to swing a wrecking ball.

______9. Used as a modern blasting technique.

_____10. Equipment generally used to remove excessive earth from building site.

a. Bulldozer

b. Disposing

c. Wrecking

d. Blasting

e. Plastic explosives

f. Salvaging

g. Cutting

h. Crane

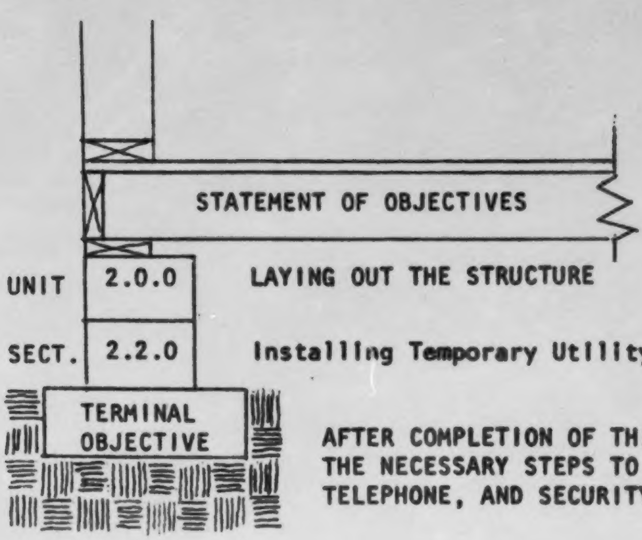
i. Burning

j. Earthmoving

# CLEARING THE SITE
## SECTION 2.1.0

### ANSWERS TO ASSIGNMENT #1

1. c
2. b
3. f
4. g
5. i
6. j
7. d
8. h
9. e
10. a



## STATEMENT OF OBJECTIVES

**UNIT 2.0.0** LAYING OUT THE STRUCTURE

**SECT. 2.2.0** Installing Temporary Utility Services

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL TAKE THE NECESSARY STEPS TO PROVIDE TEMPORARY ELECTRICAL, TELEPHONE, AND SECURITY SERVICES FOR A CONSTRUCTION SITE.

### SPECIFIC OBJECTIVES

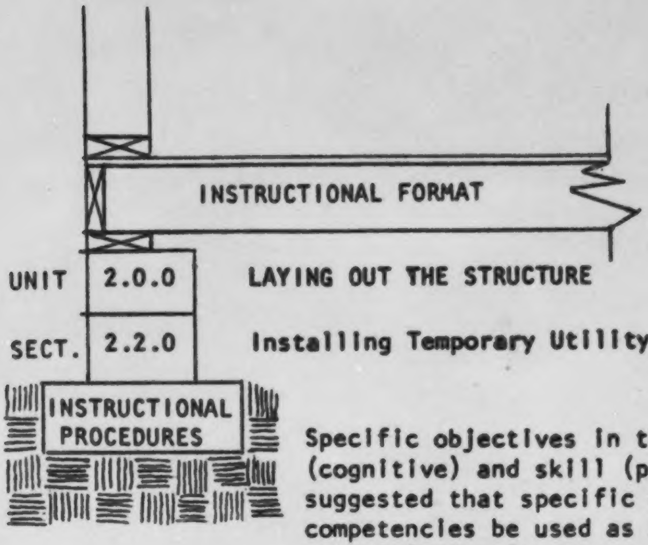
After completion of this section the learner will:

2.2.1 Locate and install a temporary electrical service according to local power company specifications.

2.2.2 Locate and make provisions for temporary telephone service according to local telephone company requirements.

2.2.3 Visit the local police department and apply for special protection during the construction period.

2.2.4 Contact all neighbors within one block of the proposed structure and respectfully solicit their cooperation in protecting the proposed construction project from possible vandalism and possible legal moves in case of injury to unauthorized visitors to the site.



# INSTRUCTIONAL FORMAT

UNIT 2.0.0 **LAYING OUT THE STRUCTURE**

SECT. 2.2.0 **Installing Temporary Utility Services**

## INSTRUCTIONAL PROCEDURES

**Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.**

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representative of local law enforcement to provide suggestions for security of tools, materials, and structure while under construction.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Temporary Electric Service From Pole
  - 2. TM 2 - Temporary Electric Service From Underground Secondary Pedestal
  - 3. TM 3 - Temporary Telephone Service
- D. Assignment sheet #1 - Location of Temporary Utilities
- E. Answers to assignment sheet #1

V. References:

- A. Class lecture activities.

## INSTALLING TEMPORARY UTILITY SERVICES
## SECTION 2.2.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Temporary electrical service

   A. Type of permanent installation

      1. Service drop

      2. Underground

      3. Relationship to temporary installation

   B. Temporary installation

      1. Power company specifications

      2. Construction needs

         a. Size

         b. Location

         c. Outlets

      3. Safety

         a. Circuit breakers

         b. Grounding

         c. Disconnect

         d. Pilfering

      4. Weather protection

II. Temporary telephone installation

   A. Location

      1. Construction office

      2. Outside location

         a. Weather protection

         b. Security

    3. Inside structure
    4. Portable
    5. Public telephone

III. Security of tools, equipment, materials and structure

  A. Local law enforcement

  B. Cooperation with close neighbors

  C. Student responsibility

IV. Typical temporary service from underground secondary pedestal

  A. Customer responsibilities

    1. Generally furnish and install the pressure treated wood support, service switch, ground rod, ground rod clamp and install the meter socket.

    2. Generally furnish and install 5/8" x 8' - 0" copper coated ground rod.

    3. Generally furnish and connect #6 copper wire to ground and support.

    4. Usually furnish conduit and weatherproof switch in accordance with local power company rules and specifications or in accordance with applicable state or national electric codes.

    5. Generally furnish and install outlets desired.

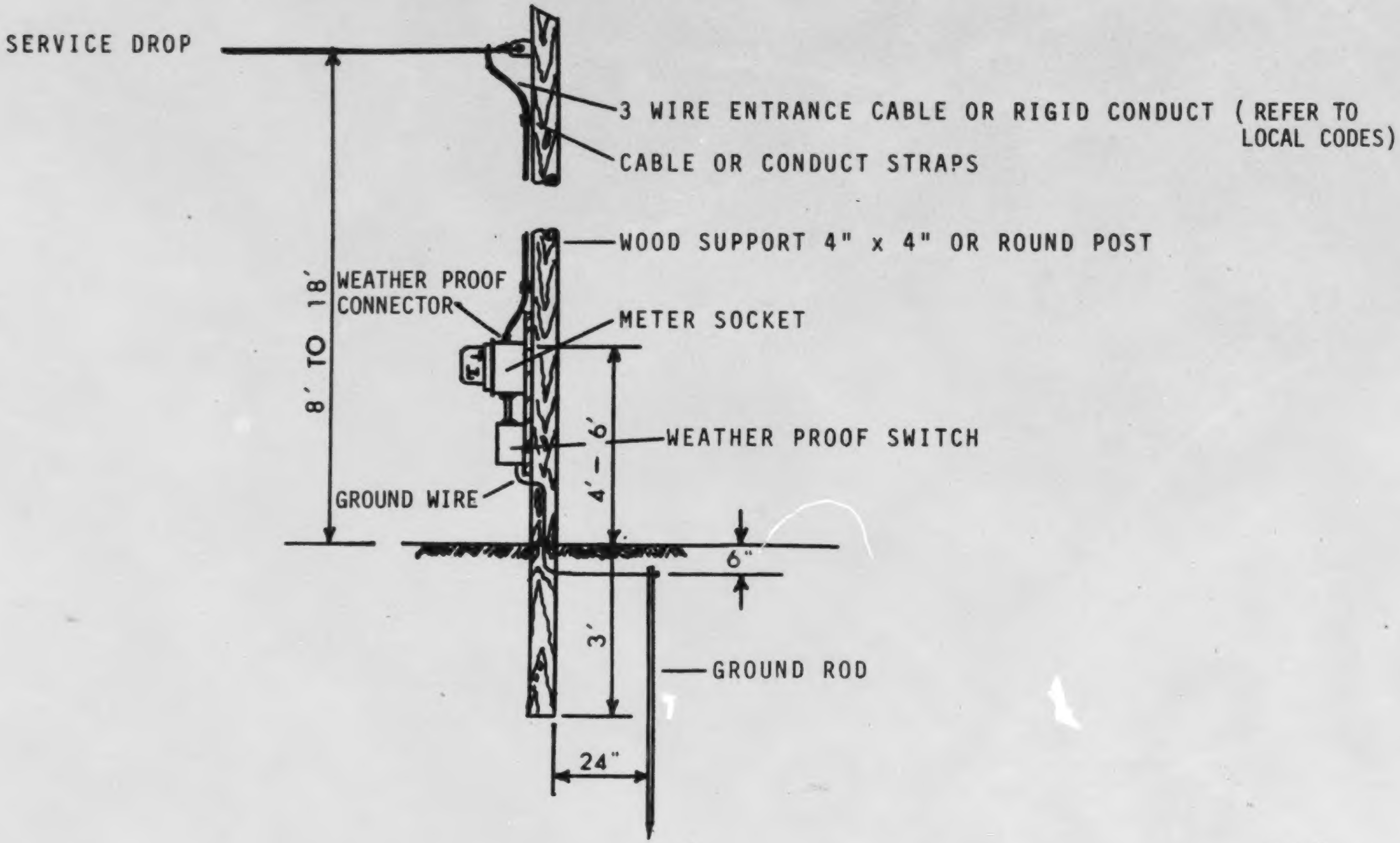
  B. Local power company responsibilities

    1. Typically furnish, install and connect service cable

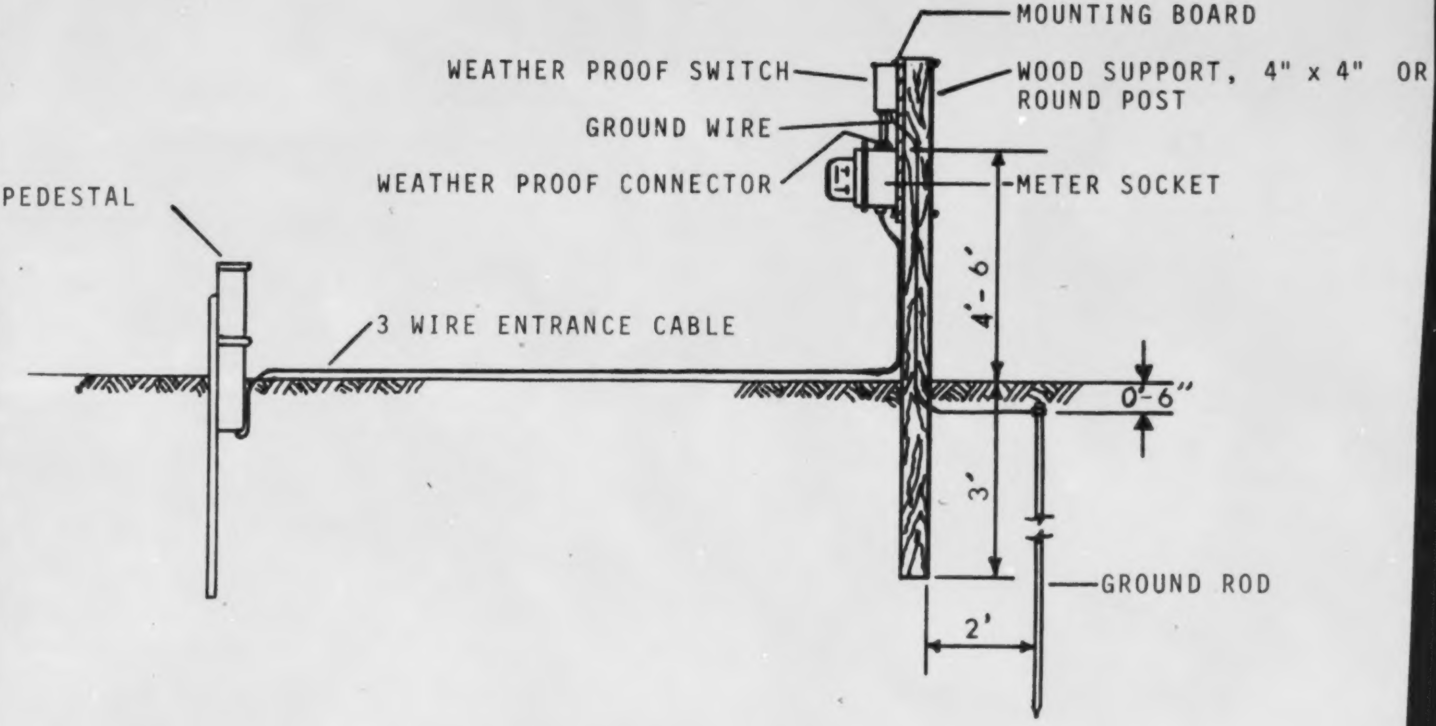
    2. Generally furnish and install electric meter

    3. Generally furnishes meter socket

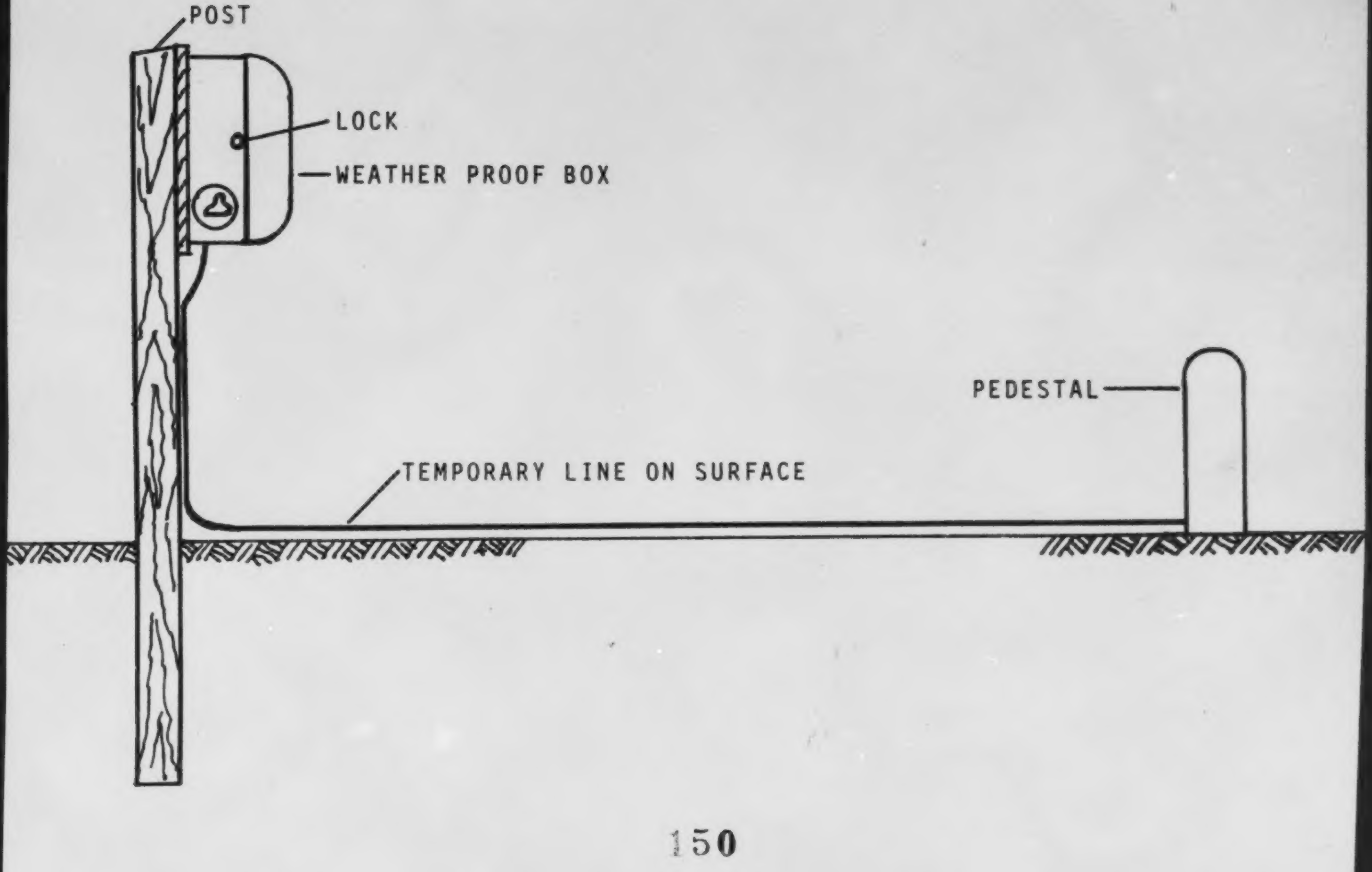
# TEMPORARY ELECTRIC SERVICE FROM POLE



# TEMPORARY ELECTRIC SERVICE FROM UNDERGROUND SECONDARY PEDESTAL



# TEMPORARY TELEPHONE SERVICE



# INSTALLING TEMPORARY UTILITY SERVICES
## SECTION 2.2.0

## ASSIGNMENT SHEET #1 - LOCATION OF TEMPORARY UTILITIES

Name ten surface and/or underground constuction activities that must be avoided at the residential construction site when selecting the temporary placement of electric and telephone services.

Areas of the residential site that must be kept free of temporary structures because of future permanent construction activities are:

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________

## INSTALLING TEMPORARY UTILITY SERVICES
## SECTION 2.2.0

### ANSWERS TO ASSIGNMENT #1

1. The structure itself
2. Driveway
3. Walks
4. Sewer line
5. Water service line
6. Gas service line
7. Telephone service line
8. Television cable
9. Garage floor drains
10. Tree and shrub locations
11. Patios
12. Decks
13. Swimming pools

## STATEMENT OF OBJECTIVES

UNIT 2.0.0 **LAYING OUT THE STRUCTURE**

SECT. 2.3.0 Initiate Topographic Alterations

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL BE ABLE TO EXAMINE A PROSPECTIVE BUILDING SITE FOR PURPOSES OF ASCERTAINING THOSE TOPOGRAPHICAL FACTORS THAT MAY LIMIT OR FACILITATE THE TYPE OF STRUCTURE THAT MAY BE BUILT ON THE SITE.

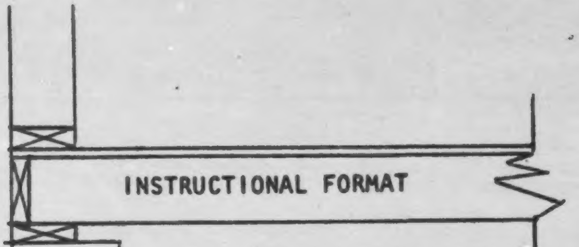
### SPECIFIC OBJECTIVES

After completion of this section the learner will:

2.3.1 Examine topsoil of prospective construction site and make recommendations for two methods of removal and storage.

2.3.2 Employ a reputable subcontractor to make topographic changes on the propsective construction site by using fill from the existing site or fill transported from off-site locations by truck if needed.

2.3.3 Employ a reputable subcontractor to complete grading and leveling operations according to specification standards and directions included on the architecutral drawings.



## INSTRUCTIONAL FORMAT

UNIT 2.0.0 **LAYING OUT THE STRUCTURE**

SECT. 2.3.0 **Intiate Topographical alterations**

**INSTRUCTIONAL PROCEDURES**

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local architectual firms, construction firms specializing in earth moving services, city engineers and members of local building inspection departments.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency master
  - 1. TM 1 - Topographical Survey Plan (see 1.6.0 - TM 2)
- D. Assignment sheet #1 - Interpreting Topographical Data
- E. Answers to assignment sheet #1

IV. References:

- A. Kicklighter, Clois E. and Ronald J. Baird. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.
- B. Spence, William P. Architecture Design Engineering Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.
- C. Steinberg, Joseph and Martin Stempel. Estimating For The Building Trades. 2nd. ed., Chicago, Illinois: American Technical Society, 1973.

# INITATE TOPOGRAPHICAL ALTERATIONS
## SECTION 2.3.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Preliminary investigations
  A. Location and elevation systems
    1. Elevation base (MSL)
    2. Monuments (bench marks)
    3. Local datum level
  B. Drainage elevations
  C. Lot corner grade markers
  D. House corner grade markers
  E. Contour lines
  F. Elevation of adjacent structure
  G. Underground installation
  H. Kind of soil

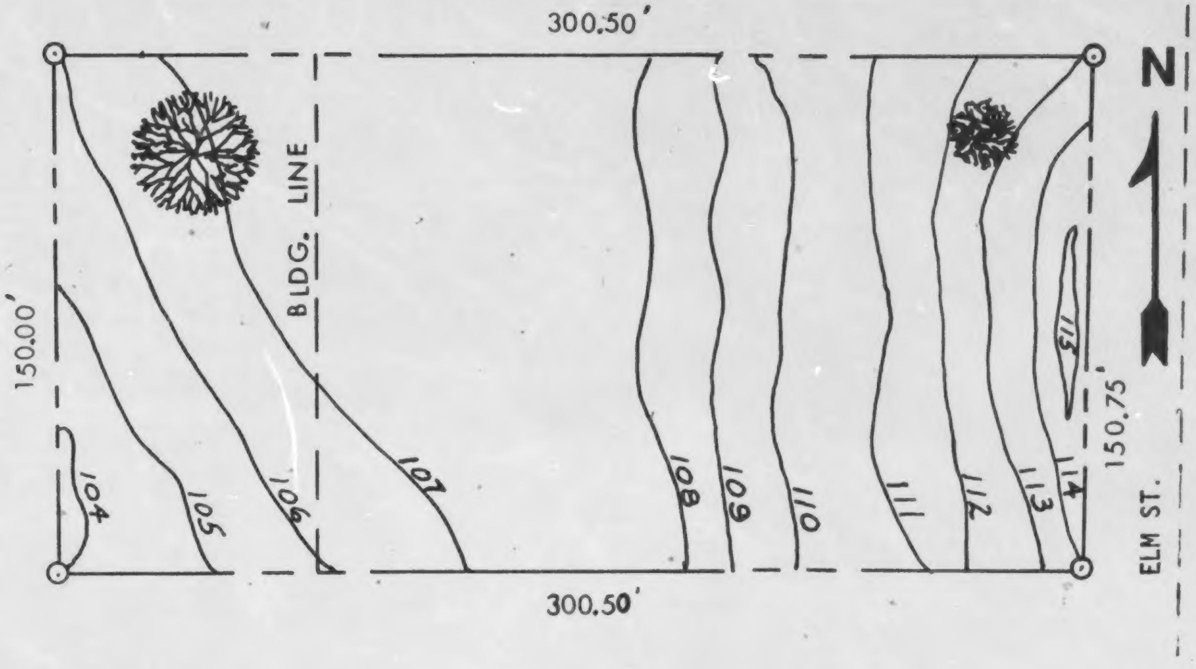
II. Top soil movement
  A. Removal methods
  B. Storage methods
  C. Special problems
    1. Rocks
    2. Trees
    3. Excessive fill or removal

- III. Final grading and leveling prior to construction
    - A. Specification sources
        - 1. Plot plan
        - 2. Survey plan
    - B. Subcontractor selection
        - 1. Bid basis
        - 2. Unbiased recommendations

## INITIATE TOPOGRAPHIC ALTERATIONS
## SECTION 2.3.0

## ASSIGNMENT SHEET #1 - INTERPRETING TOPOGRAPHIC DATA

Study the topographical survey plan bleow and write the answers to the questions.



______1. What is the elevation of the lowest corner of this contour survey?

______2. In what direction does the street side of the lot face?

______3. Where is the most appropriate position to place a one level single family residence? (1) near the front of the lot, (2) near the rear of the lot, (3) or near the center of the lot.

______4. Is it likely that fill earth will be needed on this site?

______5. What is the elevation of the highest point on this site?

______6. In what direction does this site slope upward?

______7. Which corner of the site would make a suitable location for storing topsoil?

______8. Would a private sewage disposal "dissipation field" be located on the north, south, east or west of this proposed structure?

Ascertain the elevation of each corner of the site.

______9. Southwest

_____10. Southeast

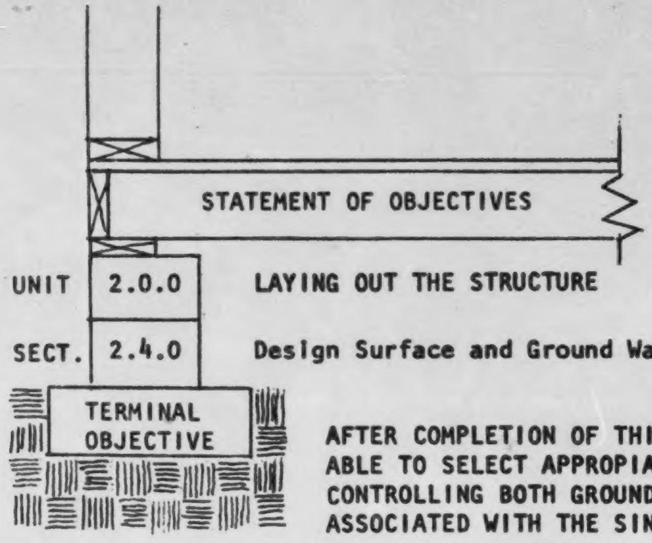
_____11. Northwest

_____12. Northeast

# INITIATE TOPOGRAPHIC ALTERATIONS
## SECTION 2.3.0

## ANSWERS TO ASSIGNMENT #1

1. 104.0 ft.
2. West
3. 3
4. No
5. 115.0 ft.
6. East
7. Southwest
8. West
9. 104.0 ft.
10. 100.0 ft.
11. 113.0 ft.
12. 114.0 ft.



## STATEMENT OF OBJECTIVES

**UNIT 2.0.0** LAYING OUT THE STRUCTURE

**SECT. 2.4.0** Design Surface and Ground Water Control Systems

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL BE ABLE TO SELECT APPROPIATE SYSTEMS FOR THE PURPOSE OF CONTROLLING BOTH GROUND AND SURFACE WATER GENERALLY ASSOCIATED WITH THE SINGLE FAMILY RESIDENTIAL STRUCTURE.

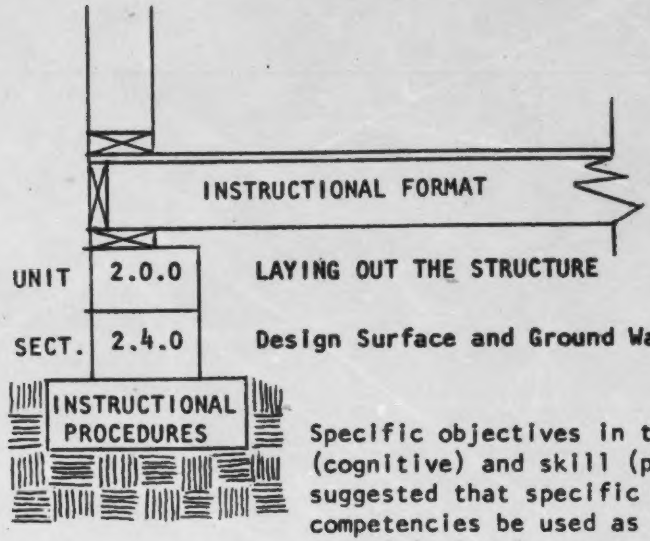
### SPECIFIC OBJECTIVES

After completion of this section the learner will:

2.4.1 Establish the direction of surface water flow according to adjacent terrain and sub-division/city/rural building code requirements.

2.4.2 Identify a commonly used basement ground water control system; list the materials used, and write the installation specifications.

2.4.3 List three methods of removing water that may collect at the site during construction.



## INSTRUCTIONAL FORMAT

UNIT 2.0.0 **LAYING OUT THE STRUCTURE**

SECT. 2.4.0 **Design Surface and Ground Water Control System**

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local city government, such as city engineer or building inspector, to provide supplementary information about surface and ground water controls. A reputable plumbing business representative may also provide this kind of information.

III. Instruction materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Lot Grading
  - 2. TM 2 - Basement/Foundation-Ground Water Control
  - 3. TM 3 - Waterproofing Walls
- D. Assignment sheet #1 - Water Control Techniques
- E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Spence, William P. Architecture Design Engineering Drawing. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

C. U.S. Department of Housing and Urban Development. Manual of Acceptable Practices to the HUD Minimum Property Standards. Washington, D. C. , U. S. Government Printing Office, 1973.

D. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# DESIGN SURFACE AND GROUND WATER CONTROL SYSTEMS
## SECTION 2.4.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Grading design for surface drainage
  A. General grading specifications
    1. Surface water flow direction
    2. Earth settlement problems
    3. Disposal of surface water
    4. Erosion conditions
    5. Grades preserved natural vegetation
    6. Slope gradients away from foundations
  B. Drainage design for surface
    1. Storm drainage system
      a. Design system
      b. Flood or natural runoff system
    2. Storm runoff capabilities
    3. Streets as runoff devices
    4. Site drainage
      a. Drainage swale
      b. Storm water drainage
    5. Downspout disposal
      a. Storm sewer
      b. Splash blocks
      c. Paved areas

II. Ground water control

- A. Footing tile drains
  - 1. Location
  - 2. Purpose
  - 3. Specifications
    - a. Size
    - b. Vertical placement
    - c. Bed material
    - d. Spacing
    - e. Joint top protection
    - f. Cover material
- B. Membrane waterproofing
  - 1. Hydrostatic pressure
  - 2. Extent of areas covered
  - 3. Purposes
  - 4. Sealant materials and specifications
    - a. Parging
    - b. Building paper (bituminous)
    - c. Polyvinyl sheet material
    - d. Bituminous coating
    - e. Number plies (coating)
      - 1. Up to 6 feet (3 plies)
      - 2. 6 to 9 feet (4 plies)
      - 3. 9 to 12 feet (5 plies)

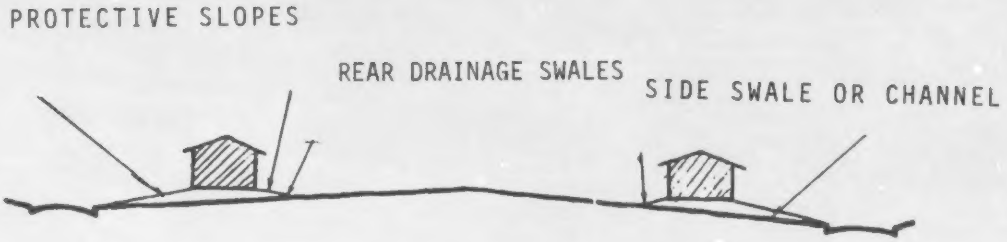
III. Methods of water removal at site during construction

A. Mechanical pumps

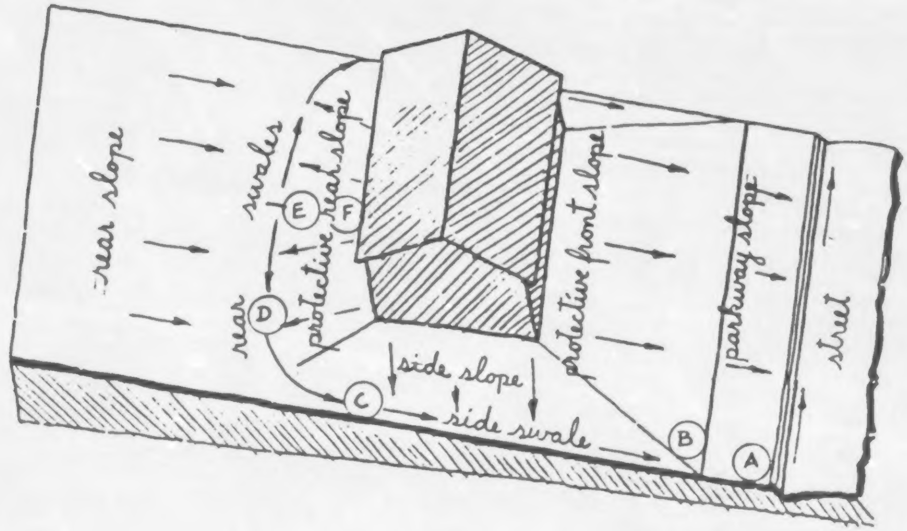
B. Lower water table in area (usually commercial)

C. Ditching

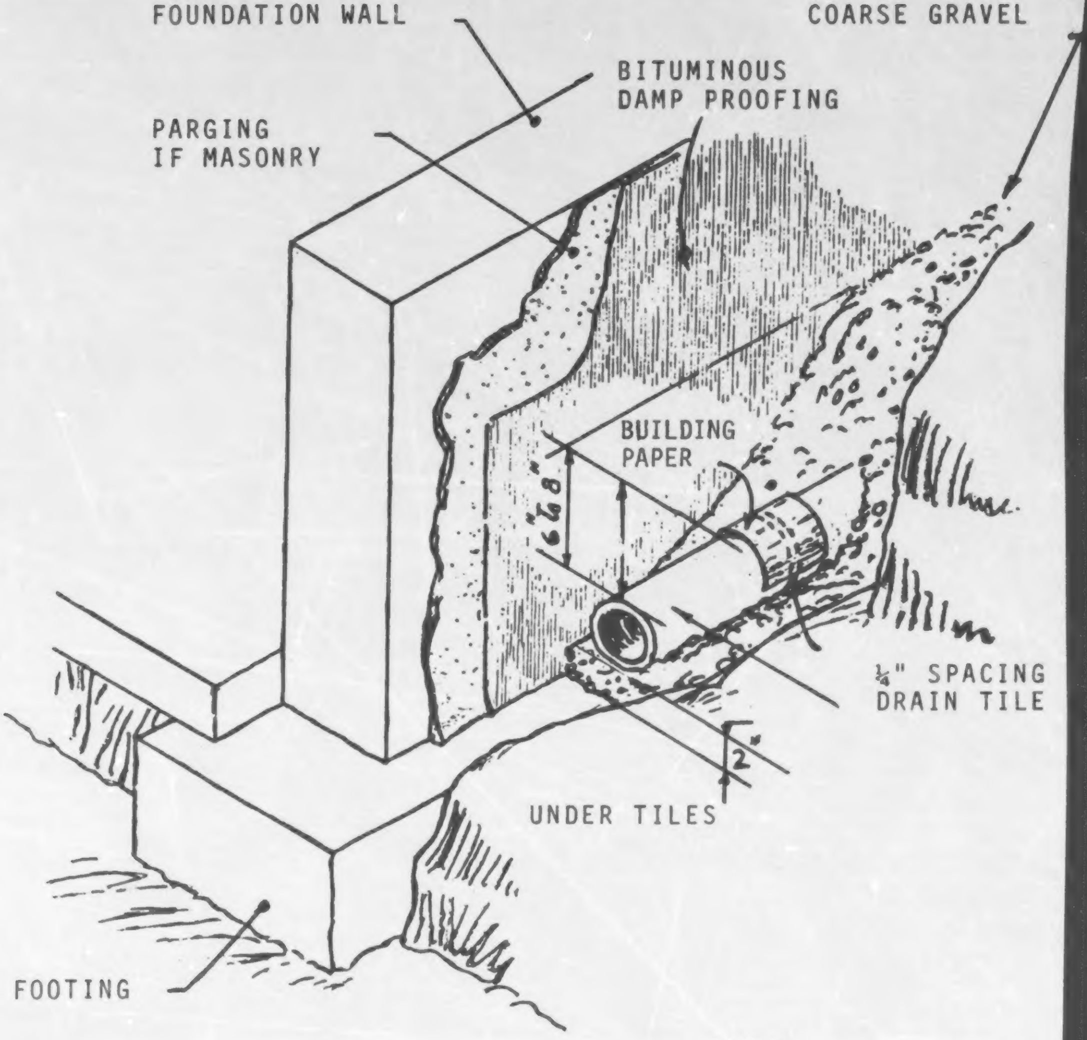
# LOT GRADING



DRAINAGE TO STREET

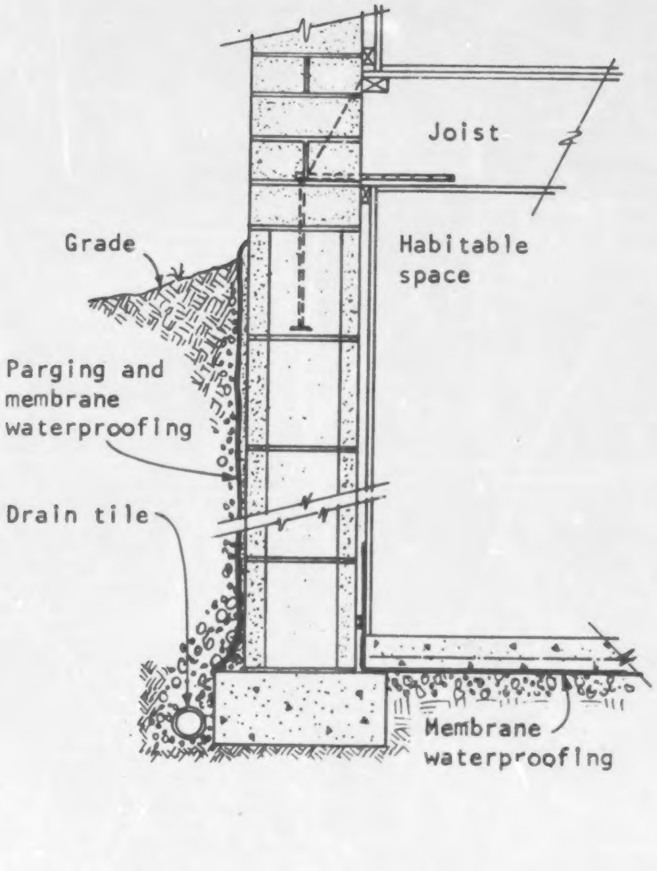


# GROUND WATER CONTROL



2.4.0 - TM 2

# WATERPROOFING WALLS



## DESIGN SURFACE AND GROUND WATER CONTROL SYSTEMS
## SECTION 2.4.0

### ASSIGNMENT SHEET #1 - WATER CONTROL TECHNIQUES

After studying the information in the references, match the terms in the right-hand column with the correct descriptions in the left-hand column.

_______1. A method of removing surface water from a construction site

_______2. A method of directing ground water away from foundation or basement wall

_______3. A thin coat of cement plaster used to smooth rough masonry walls

_______4. A small masonry block or form laid with the top close to the ground surface to receive drainage of rain water from the roof and to carry it away from the building

_______5. A drainage channel formed by the convergence of intersecting slopes.

_______6. Water pressure existing below ground level

_______7. Natural water runoff system

_______8. Man made surface storm drainage devices.

_______9. Underground storm water disposal

______10. A method of preventing water from penetrating foundation/basement walls

a. Swale

b. Hydrostatic pressure

c. Membrance waterproofing

d. Ditching

e. Storm sewer

f. Splash block

g. Footing tile drains

h. River or stream

i. Streets

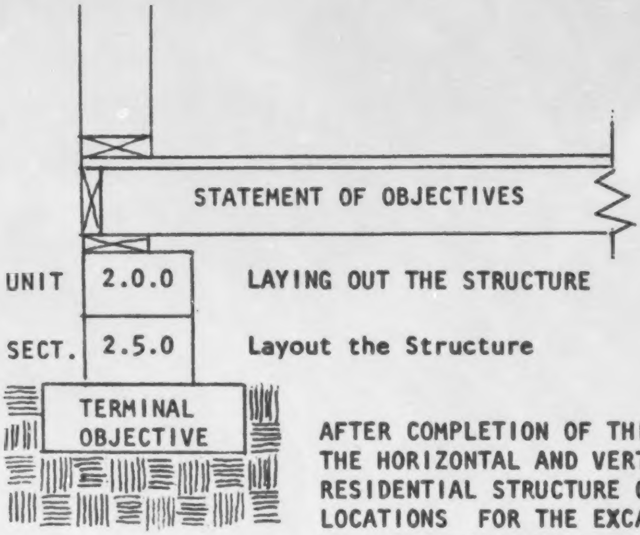
j. Parging

k. Water table

# DESIGN SURFACE AND GROUND WATER CONTROL SYSTEMS
## SECTION 2.4.0

### ANSWERS TO ASSIGNMENT #1

1. d
2. g
3. j
4. f
5. a
6. b
7. h
8. i
9. e
10. c



## STATEMENT OF OBJECTIVES

UNIT 2.0.0 LAYING OUT THE STRUCTURE

SECT. 2.5.0 Layout the Structure

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL LOCATE THE HORIZONTAL AND VERTICAL POSITIONS OF A PROPOSED RESIDENTIAL STRUCTURE ON A SITE. WIDTH, DEPTH AND HEIGHT LOCATIONS FOR THE EXCAVATION, FOOTING AND FOUNDATION WALL POSITIONS WILL BE CALCULATED WITH THE USE OF LEVELING EQUIPMENT AND PLACED UPON SUITABLE MARKER STAKES, SUCH AS BATTER BOARDS, AND MADE READY FOR EXCAVATION OPERATIONS. ALL ELEVATION DECISIONS WILL BE MADE AFTER CAREFUL EXAMINATION OF SURFACE DRAINAGE SPECIFICATIONS.

### SPECIFIC OBJECTIVES

After completion of this section the learner will:

2.5.1 Varify the property boundaries according to measurements on the site plot plan. (A metal surveyor's pin should exist at each corner of the property.)

NOTE: A SHOVEL IS USUALLY NEEDED TO UNCOVER PINS

2.5.2 Stake the ends of the building setback line and side yard distance requirements to within ± - 1/4 inch.

2.5.3 Stake out location of the outer walls of the structure by measuring from an established reference line (building setback line) and drive stakes at all corners of the structure.

2.5.4 Set up and level a builder/transit level to bubble level observation accuracy.

2.5.5 Ascertain the bench mark from which elevation distances are measured according to the architectural drawing and calculate the height of the foundation top.

2.5.6 Establish elevation to assure correct driveway slope, surface drainage direction and slope. Follow specifications according to architectural drawings or Federal Housing Administration specifications.

2.5.7 Calculate the excavation depth and mark on 2 x 4 stakes driven in the ground at approximately 45° angles and four feet away from each outside corner of the structure.

> NOTE: WHEN USING SOIL AS A FOOTING FORM FOR CONCRETE, REDUCE THE EXCAVATION DEPT BY THE FOOTING THICKNESS PLUS TWO INCHES TO REDUCE SPILLOUT WHEN PLACING CONCRETE IN DUG TRENCHES (FORMS).

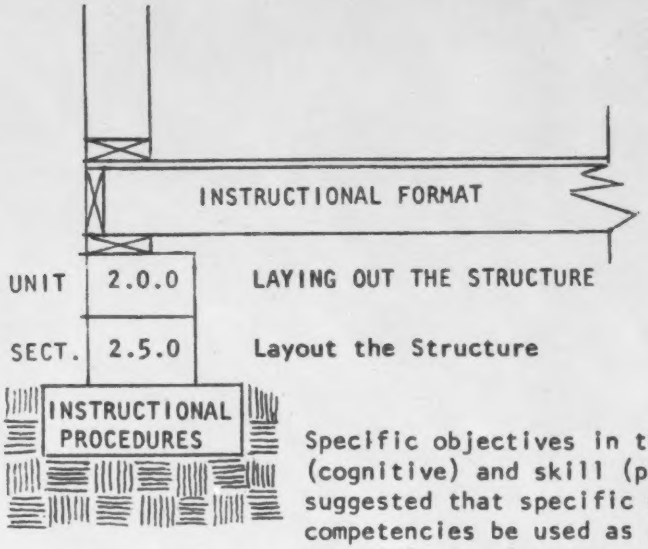
2.5.8 List three purposes that batter boards serve as a construction device.

2.5.9 Erect and level batter boards at all corners of the proposed foundation wall to a tolerance of ± - 1/8 inch.

2.5.10 Establish the outline of the foundation wall by measuring and marking on the top surface of the horizontal members of the batter boards.

2.5.11 Square the foundation layout to within ± - 1/4 inch by stretching string or light wire to represent the outside edge of the foundation walls and compare the diagonal measurements.

2.5.12 Establish footing line locations on batter boards to tolerance of ± - 1/8 inch.



INSTRUCTIONAL FORMAT

UNIT 2.0.0 **LAYING OUT THE STRUCTURE**

SECT. 2.5.0 **Layout the Structure**

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local construction businesses, city engineering department, skilled labor organizations and/or architectual firms who may provide supplemental residential layout information.

III. Instructional materials used in this section:

A. Statement of objective sheet

B. Information sheet

C. Transparency masters.

1. TM 1 - Builder's Level
2. TM 2 - Level Transit
3. TM 3 - Reading A Level
4. TM 4 - Reading the Rod
5. TM 5 - Laying Out Corners
6. TM 6 - Laying Out Stakes
7. TM 7 - Diagonal of A Rectangle

D. Assignment sheet #1 - Site Preparation

E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company Inc., 1976.

B. Durbahn, Walter E. and Robert E. Putman. Fundamentals of Carpentry: Tools, Materials and Practices. Chicago, Illinois: 5th. ed., American Technical Society, 1977.

C. Durbahn, Walter E. and Elmer W. Sundberg. Fundamentals of Carpentry: Practical Construction. Chicago, Illinois: 5th. ed., American Technical Society, 1977.

D. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# LAYOUT THE STRUCTURE
## SECTION 2.5.0

## INFORMATION SHEET - CONTENT OUTLINE

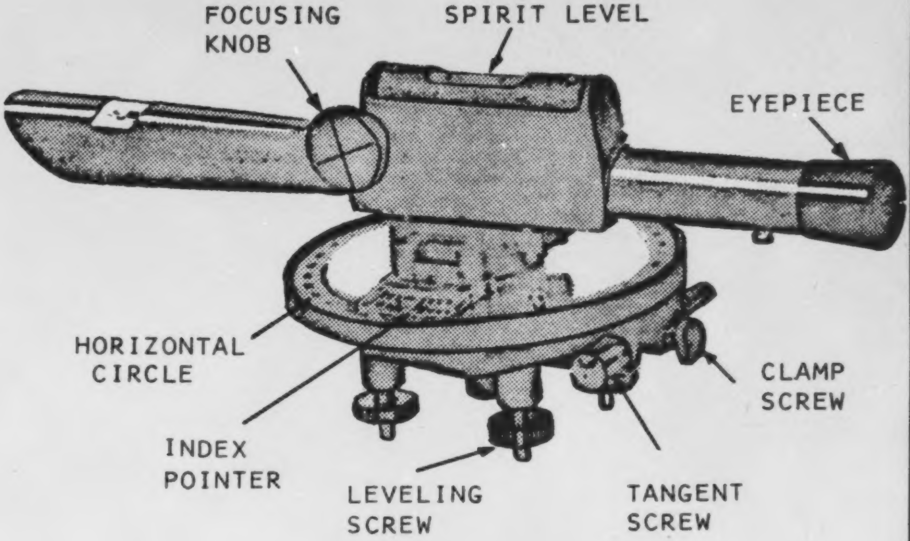
I. Preliminary layout information
  - A. Community building code regulations
  - B. Sub-division building code restrictions
  - C. Lot lines
    - 1. Locate surveyor's pins
    - 2. Check for accuracy
  - D. Building lines
    - 1. Setback requirement
    - 2. Side yard distance requirement
    - 3. Locate location of outer walls

II. Elevation requirements
  - A. Builders level
    - 1. Set up and level
    - 2. Reading the rod
  - B. Calculate height of foundation top
  - C. Elevation criteria
    - 1. Driveway slope
    - 2. Surface water drainage direction
    - 3. Slope requirements
    - 4. Adjacent lot elevation
  - D. Calculate excavation depth

III. Batter boards

- A. Purposes
  1. Location of building (foundation wall line)
  2. May represent height of foundation wall
  3. Location of footing lines
- B. Construction
- C. Location
- D. Leveling
- E. Squaring the layout
- F. Footing line locations

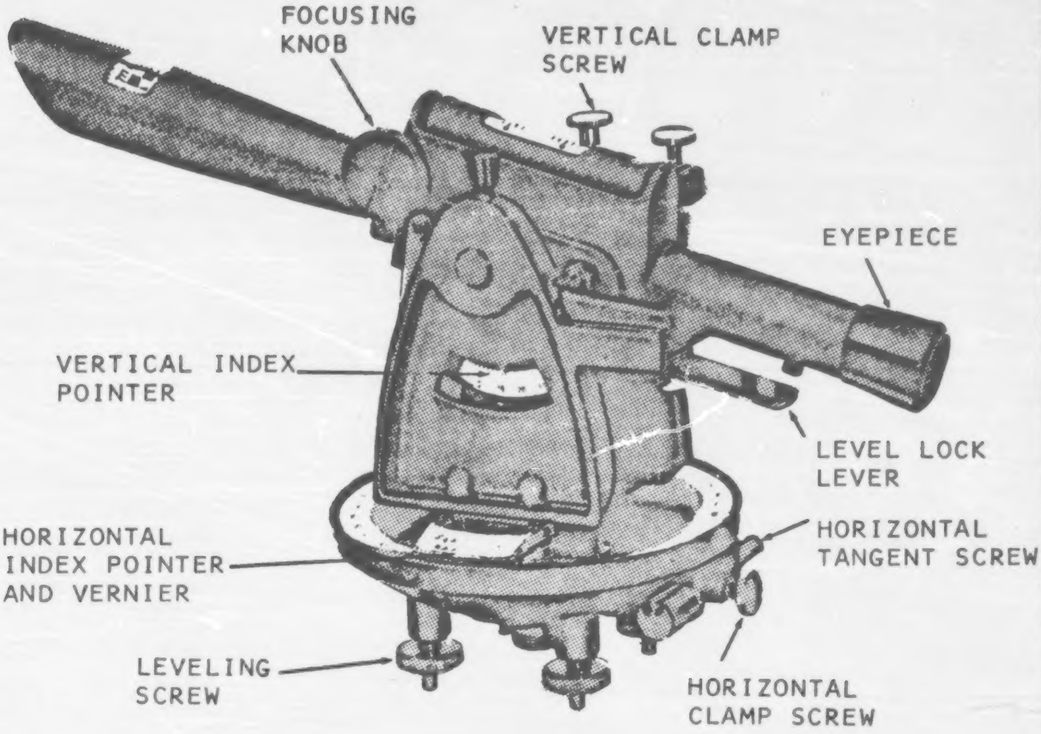
# BUILDER'S LEVEL



2.5.0 - TM 1

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

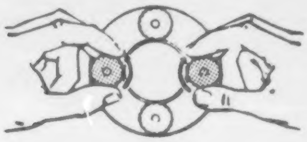
# LEVEL-TRANSIT



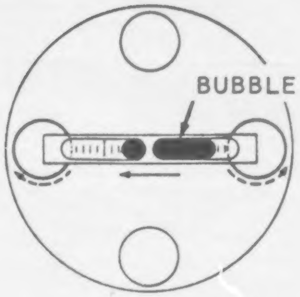
2.5.0 - TM 2

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

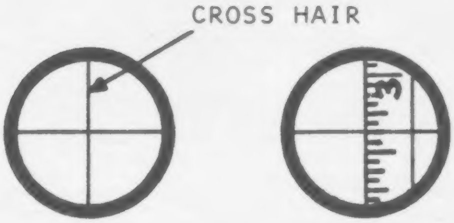
# READING A LEVEL



ADJUSTING THE LEVELING SCREWS



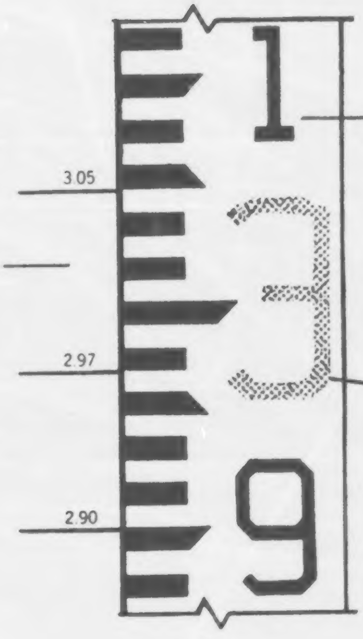
THE BUBBLE OF THE SPIRIT LEVEL
MOVES IN THE SAME DIRECTION
AS THE LEFT THUMB.



VIEW THROUGH THE TELESCOPE.
LEFT: CROSS HAIRS. RIGHT:
OBJECT IN VIEW.

COURTESY OF
GOODHEART-WILLCOX CO. INC:
MODERN CARPENTRY
IML-UMC

# READING THE ROD



TENTHS OF FEET

(BLACK)

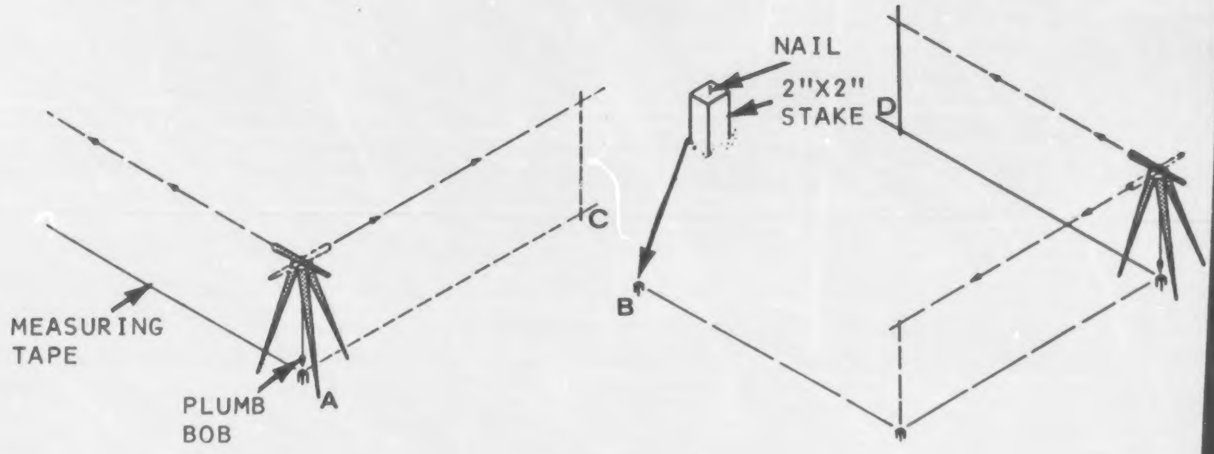
HUNDREDTHS OF FEET

(BLACK AND WHITE)

FULL FOOT NUMBERS

(RED)

# LAYING OUT CORNERS

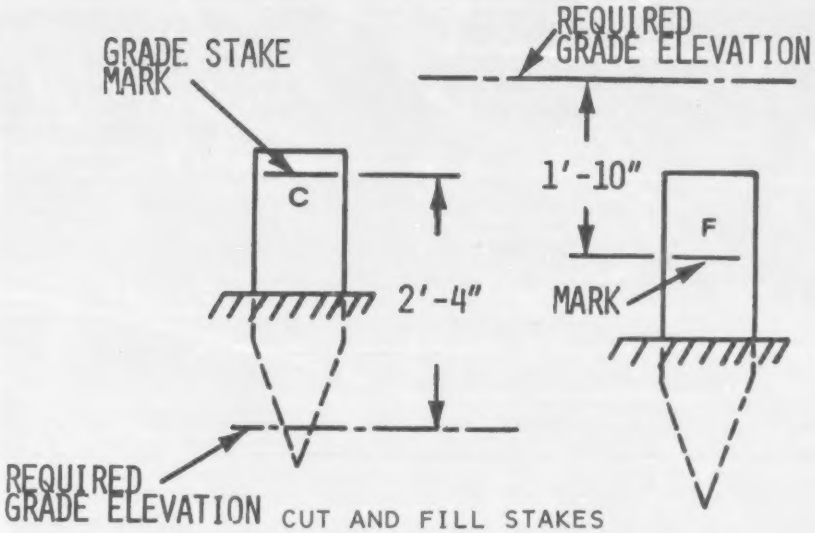


NOTE: THE ROD MUST BE KEPT EXACTLY VERTICAL WITH A PLUMB LINE OR A CARPENTERS' LEVEL

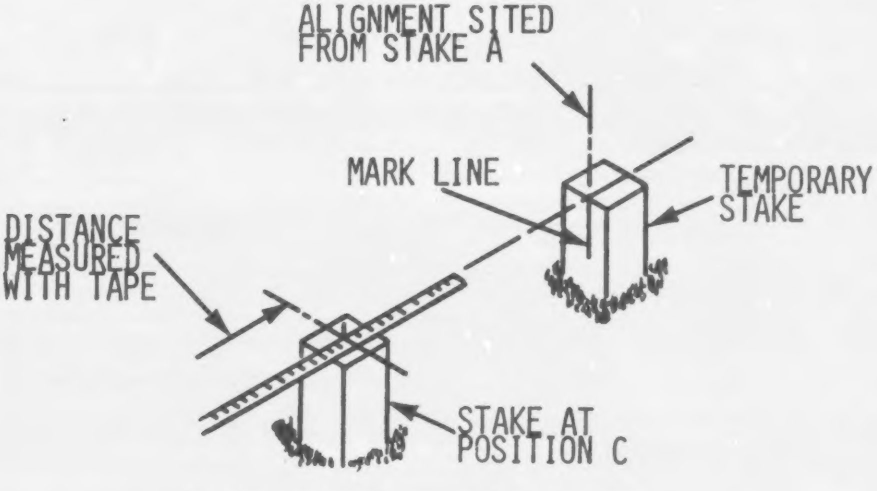
2.5.0 - TM 5

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

# LAYING OUT STAKES



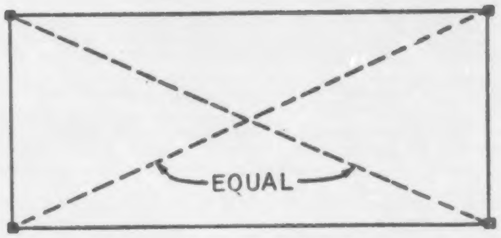
CUT AND FILL STAKES



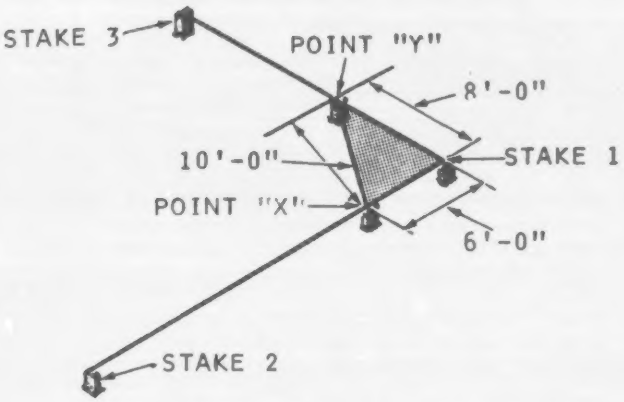
ESTABLISHING AN EXACT POINT
FOR A LAYOUT WITH THE AID OF
A TEMPORARY STAKE

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

# DIAGONAL OF A RECTANGLE



DIAGONALS OR A SQUARE OR RECTANGLES WILL BE EQUAL IN LENGTH. ALWAYS APPLY THIS FINAL CHECK TO BUILDING LINES.



THE RIGHT ANGLE AT POINT 1 CAN BE LAID OUT USING THE 6-8-10 METHOD.

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

## LAYOUT THE STRUCTURE
## SECTION 2.5.0

### ASSIGNMENT SHEET #1 - SITE PREPARATION

After studying the information in the references, match the terms in the right-hand column with the correct description in the left-hand column.

______1. A stake placed into the ground that locates the finished level of the ground at that point

______2. A metal or stone elevation marker placed in the ground by a surveyor for use as a reference point when ascertaining grades and elevations in an area

______3. Ground level at the building line.

______4. Materials used to raise the grade level

______5. A rod, usually graduated in tenths and hundredths of a foot, used in leveling with the builder's level

______6. An instrument consisting of a telescope, leveling bubble and tripod used primarily for establishing grade levels

______7. Relating to the slope of a line such as inches of fall per foot of run

______8. The lot on which a building is to be constructed

______9. An agreement between the builder and a city that explains in detail the type, quality and extent of construction to be preformed

______10. To remove soil for the purpose of establishing a uniform grade or for footing construction

a. Site

b. Leveling rod

c. Grade stake

d. Grade line

e. Fill

f. Fall

g. Excavate

h. Builders level

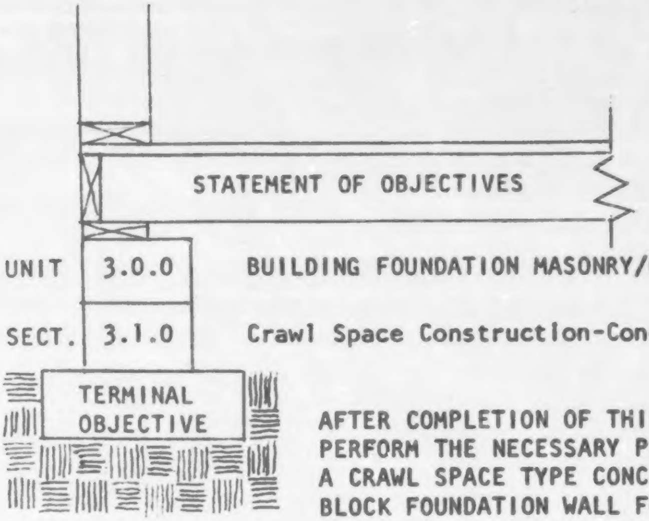
i. Building permit

j. Bench mark

# LAYOUT THE STRUCTURE
## SECTION 2.5.0

## ANSWERS TO ASSIGNMENT #1

1. c
2. j
3. d
4. e
5. b
6. h
7. f
8. a
9. i
10. g



## STATEMENT OF OBJECTIVES

UNIT 3.0.0 BUILDING FOUNDATION MASONRY/CONCRETE WALLS

SECT. 3.1.0 Crawl Space Construction-Concrete Block

TERMINAL OBJECTIVE

AFTER COMPLETION OF THIS SECTION THE LEARNER WILL PERFORM THE NECESSARY PLANNING AND CONSTRUCTION OF A CRAWL SPACE TYPE CONCRETE FOOTING AND CONCRETE BLOCK FOUNDATION WALL FOR A SINGLE FAMILY RESIDENTIAL STRUCTURE. CALCULATIONS NECESSARY TO ASCERTAIN THE QUANTITY OF MATERIALS NEEDED WILL BE EXPERIENCED. RELATED ACTIVITIES TO BE INCLUDED IN THIS SECTION ARE WATER SERVICE INSTALLATIONS, CONCRETE AND MORTAR INGREDIENTS, BLOCK LAYING SKILLS, TERMITE PROTECTION, BACKFILLING AND ROUGH GRADING.

## SPECIFIC OBJECTIVES

After completion of this section, the learner will:

3.1.1 Name two pieces of mechanical equipment usually employed for the removal of soil prior to the construction of footings and foundation walls in crawl space and basement construction.

3.1.2 Employ a competent sub-contractor to excavate to a predetermined depth as indicated on the corner batter board stakes. The learner will check depth and serve as an assistant to the earth moving equipment operator.

> NOTE: WHEN USING A TRENCH IN THE SOIL AS A FOOTING FORM FOR CONCRETE, REDUCE THE CRAWL SPACE EXCAVATION DEPTH BY 2 INCHES TO MINIMIZE SPILLOUT WHEN PLACING CONCRETE IN THE TRENCH. (FORMS)

3.1.3 Draw to scale a cross section of a rectangular and a flared footing recommended for use in the construction of the typical single family residence. Dimension the height, width, maximum projection of the footing and the foundation wall width.

3.1.4 Name two techniques for preparing foundation wall and pier footing forms. Include materials, sizes and placement of forms parts.

3.1.5 Layout and construct foundation wall footing forms and prepare earth footing forms by trenching into the soil to a specified width and depth.

3.1.6 Calculate the elevation for the top of the foundation wall footing and the top of pier footings.

3.1.7 Locate and place leveling pins in the trenched footing forms at each wall intersection, spaced approximately eight feet on center and centered between the sides of the trench. Set leveling pin height by string or builders level.

3.1.8 Locate public water main, layout location of trench to approximate center of excavation, excavate trench to depth required by local plumbing code, and employ sub-contractor to install water service line and meter housing.

> NOTE: WATER IS NEEDED TO MIX MORTAR FOR BLOCK FOUNDATION WALL CONSTRUCTION.

> NOTE: WATER METER HOUSING INSTALLATIONS ARE COMPLETED BY CITY EMPLOYEES IN SOME COMMUNITIES. WATER AND SEWER TAPS ARE GENERALLY SUPERVISED OR PREFORMED BY WATER DEPARTMENT EMPLOYEES.

3.1.9 List in writing the ingredients used to prepare concrete and the primary function of each.

3.1.10 Write the meaning of a concrete mix consisting of a "ratio of 1:1:4".

3.1.11 Calculate the cubic yards of concrete needed for the foundation footings of a proposed residential structure.

3.1.12 Place and level five (5) bags of redi-mix concrete in foundation wall and pier footing forms.

3.1.13 List two plastic (wet) mortar properties and three hardened mortar properties.

3.1.14 Classify the mortar type recommended for general use in above grade masonry and give the preparation limitations of the mortar mix in volume as recommended by ASTM. (American Society for Testing and Materials)

3.1.15 Measure and mix mortar ingredients until the mortar is uniform, cohesive, and of a consistency that makes it usable.

3.1.16 List four characteristics of mortar that has been properly prepared.

3.1.17 Add water to mixed mortar that has stiffened (less plasticity) because of evaporation in amounts to regain the proper workability to the mix.

3.1.18 Spread mortar on masonry units (concrete blocks) until the fundamental skills have been developed.

3.1.19 Sketch to scale six common types of tooled mortar joints.

3.1.20 Tool vertical and horizontal mortar joints in concave joints when the mortar has become "thumbpring hard" or when the mortar is compacted.

3.1.21 To reduce cutting, establish head joint location and allowance for mortar joints by stringing out (placing) the first course of masonry wall without mortar. Adjust for minimum cutting by varying size or mortar joint between masonry units.

3.1.22 Layout and cut concrete line blocks to specified lengths within a tolerance of ± - 1/8 inch.

3.1.23 Layout and saw concrete line blocks to specified length.

3.1.24 Layout concrete block corner lead four or five courses above the footing. Each course is to be aligned, level, and plumb as it is laid.

3.1.25 Lay stretcher (line) blocks between the corner leads to line.

NOTE: REMEMBER TO PLACE CRAWL SPACE FOUNDATION VENTS, WINDOWS, FAN EXHAUSTS, ETC. WHEN SPECIFIED ON ARCHITECTURAL DRAWINGS.

3.1.26 Cut to size and lay up a closure block in one or more courses.

3.1.27 Layout and lay up concrete block piers according to local building codes or as specified in the Federal Housing Administration Minimum Property Standards for one and two living units.

3.1.28 Construct a pilaster with concrete blocks of two widths alternating the two size (width) blocks for the purpose of tying the pilaster into the foundation wall.

3.1.29 Construct a load bearing wall intersection by installing a metal tiebar for lateral support.

3.1.30 Tie a nonbearing block wall to an adjacent wall using strips of metal lath or 1/4 inch mesh galvanized hardware cloth.

3.1.31 Place wood foundation sill anchor bolts at approximate 4 foot intervals in the cores of the top two courses of blocks directly beneath the foundation sill.

3.1.32 List at least four types of insulation that is available for the purpose of decreasing the rate of heat loss through crawl space and basement foundation walls.

3.1.33 Install insulation to crawl space perimeter/basement perimeter wall to provide an "R" value not exceeding that for the first floor exterior walls.

3.1.34 List three common methods of termit protection recommended for use in the particular geographic area where the construction is occuring; select the appropriate method of control and install, apply, or treat as circumstances dictate.

3.1.35 Employ a competent sub-contractor to backfill the excavation and rough grade the earth to the established grade line outside the foundation walls.

## INSTRUCTIONAL FORMAT

UNIT 3.0.0 **BUILDING FOUNDATION MASONRY/CONCRETE WALLS**

SECT. 3.1.0 **Crawl Space Construction-Concrete Block**

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

   A. Provide learner with statement of objectives sheet

   B. Discuss terminal and specific objectives

   C. Provide learner with instruction sheets for use with this section

   D. Explain evaluation procedures

II. Suggested instructional methods:

   A. Demonstration - to show manipulative operations at construction site

   B. Discussion - to encourage question and answer activities

   C. Team assignment - to enhance personal relationships in the work environment.

   D. Illustrated lecture - to introduce a lesson or focus attention

   E. Field trips - to illustrate construction techniques and application of materials

   F. Consultant - representatives of local construction business firms that specialize in the sale of earth moving equipment, masonry materials and supplies, redi-mix concrete, water and sewer services, and termit protection service for supplentntal information related to foundation construction.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  1. TM 1 - Footing
  2. TM 2 - Laying Out Forms For Footing
  3. TM 3 - Mortar Joints
  4. TM 4 - Shapes and Sizes Of Typical Concrete Masonry Units
  5. TM 5 - Block Wall Patterns
  6. TM 6 - Termit Shields
  7. TM 7 - Installation Of Termit Shields
  8. TM 8 - Termit Barriers For Slab-On-Ground Construction
  9. TM 9 - Application of Chemical Soil Treatment
- D. Assignment sheet #1 - Excavation and Footing Construction
- E. Assignment sheet #2 - Foundation Wall Construction, Insulation, Termite Control and Backfilling
- F. Answers to assignment sheets #1 and 2

IV. References:

- A. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc. 1976.
- B. Kicklighter, Clois E. Modern Masonry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1977.
- C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# CRAWL SPACE CONSTRUCTION - CONCRETE BLOCK
## SECTION 3.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Excavation procedures
   - A. Mechanical equipment
     1. Bull dozer
     2. Back hoe
     3. End loader
     4. Costs

II. Footing design
   - A. Types and sizes
     1. Rectangular
     2. Flared
     3. Stepped
   - B. Footing and pier forms
     1. Soil sides
     2. Form boards

III. Foundation wall footing
   - A. Height factors
     1. Frost level
     2. Foundation wall height
     3. Datum
     4. Surface drainage requirement
     5. Driveway slope
     6. Finish grade

- B. Footing elevation calculations
    - 1. Top elevation
    - 2. Bottom elevation
- C. Leveling trenched footings

IV. Water service

- A. Sources
- B. Trenching
    - 1. Width
    - 2. Depth
- C. Meter location
- D. Type of water line
    - 1. Galvanized steel pipe
    - 2. Copper tubing
    - 3. Plastic pipe
    - 4. Code requirements

V. Concrete mix ingredients

- A. Cement
- B. Sand
- C. Aggregate
- D. Water
- E. Proportions
    - 1. 1 - Cement
    - 2. 3 - Sand
    - 3. 4 - rock

4. 2.5 - 3 gal. water
    a. Field conditions
    b. Strength factor

VI. Estimating quantity of concrete
  A. Cubic yard method: Cu. yds. = $\frac{W \times L \times T}{27}$
  B. Estimating table
    1. Sq. ft. area one cu. yd. of concrete will fill
    2. Example : 4" thickness will fill 81 sq. ft.

VII. Placing and leveling concrete in footing forms
  A. Method of transportation to forms
    1. Ready-mix truck
    2. Wheelbarrow
  B. Leveling
    1. Forms
    2. pins
  C. Footing
  D. Finishing
  E. Curing

VIII. Mortar properties
  A. Plastic
    1. Workability
    2. Water retentivity
  B. Hardened
    1. Compressive strength
    2. Bond strength
    3. Durability

IX. Types of mortar

  A. M - high compressive strength
  B. S - medium high strength
  C. N - medium strength
  D. O - low strength
  E. K - very low strength
  F. Limitation of mortar mix in volume, type N
    1. Parts by volume - 1
    2. Aggregate, measured in damp, loose condition not less than 1/2 and not more than 3 times the sum of the volumes of the cement and lime used

X. Measuring and hand mixing mortar ingredients

  A. Tools and equipment
    1. Mortar box
    2. Mortar hoe
    3. Hod carrier
  B. Batching mortar ingredients - power mixer
  C. Dry mixing materials
  D. Initial water amounts

XI. Characteristics of properly prepared mortar

  A. Easy to spread
  B. Cling to vertical faces of masonry units
  C. Extrudes from mortar joint without dripping or smearing
  D. Supports weight of masonry unit being used

XII. Importance of water content in mortar

  A. Controls workability

  B. Water retention ability of mortar

XIII. Spreading mortar

  A. Mastery of skill

  B. Holding trowel

  C. Trowel size

  D. Methods of loading the trowel

  E. Wrist and arm movement techniques

XIV. Common types of tooled motar joints

  A. Troweled

  B. Tooled

    1. Concave

    2. V-shaped

    3. Weathered

    4. Struck

    5. Rough cut or flush

    6. Raked

    7. Extruded

  C. Tooling timing

XV. Procedure for laying concrete block wall

  A. General considerations

    1. Standard block size

    2. Bonds

3. Bedding of mortar
4. Weather protection
    a. Concrete blocks
    b. Finished wall
5. Mortar quality
    a. Cement type
    b. Cement quality
    c. Workability
    d. Texture of bedding areas
    e. Block moisture absorbtion rate
    f. Water retention of mortar

B. Steps of procedure
    1. Outside wall line
    2. Layout by string out
    3. Mortar joint thickness
    4. Mortar bed
    5. Lay corner block
    6. Lay stretcher blocks
    7. Level and plumbing techniques
    8. Lay corner leads
    9. Lay line blocks
    10. Lay closure block
    11. Tool mortar joints
    12. Dried particle removal

XVI. Methods of cutting concrete blocks

- A. Brick hammer and blocking chisel
- B. Masonry saw

XVII. Concrete block construction details

- A. Pier
  - 1. Definition-isolated section or column of masonry
  - 2. Pier construction details
    - a. Footing size - 8 x 16 hollow unit, 8" x 24" x 24"
- B. Pilaster
  - 1. Definition - a masonry column bonded to a wall
  - 2. Pilaster construction details
- C. Wall intersections
  - 1. Loadbearing
    - a. Metal tie bar
    - b. Size and placement - 1/4" x 1 1/4" x 28" x 4' vertical
  - 2. Non-loadbearing
    - a. Metal lath/hardware cloth
    - b. Placement
- D. Wood sill foundation anchor bolts
  - 1. Sizes - 1/2 x 18"
  - 2. Placement

XVIII. Types of foundation/basement wall insulation

- A. Flexible
  - 1. Blanket
  - 2. Batt

    3. Sizes
    4. Application

- B. Foamed or sprayed
    1. Foamed in place
    2. Sprayed
    3. Expanded polystyrenes
    4. Urethane plastic foams
- C. Rigid sheets
    1. Polystyrene
    2. Urethane
    3. Thicknesses
    4. Application

XIX. Termite protection

- A. Termite shields
    1. Materials
    2. Size
    3. Location
- B. Chemical treatment of lumber
- C. Soil treatment
    1. Pesticides
        - a. Water emulsions of aldrin (0.5%)
        - b. Chlordane (1.0%)
        - c. Dieldrin (0.5%)
        - d. Heptachlor (0.5%)
    2. Location of treatment

        a. Adjacent to foundation wall/footing
        b. Adjacent to pier footing
    3. Application safety
        a. Garden sprinkling can
        b. Isolate containers
        c. Storage suggestions
        d. Personal hygene after use
        e. Drifting and inhalation dangers

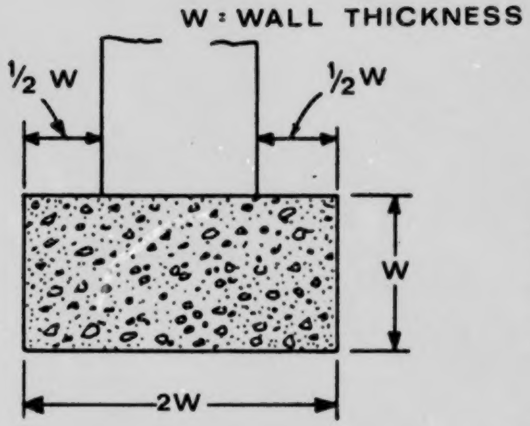
XX. Backfilling and rough grading

- A. Equipment
    1. Bulldozer
    2. Endloader
    3. Backhoe
    4. Tractor with grading attachments
- B. General considerations
    1. Timing
    2. Soil condition
    3. Settling adjustments
    4. Wall strength
    5. Obstructions

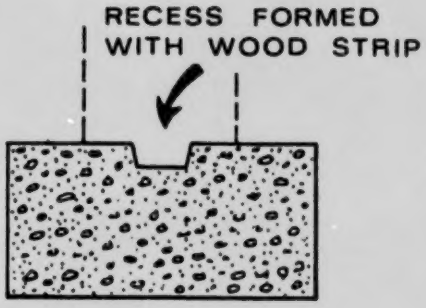
# FOOTING

| TYPE OF SOIL | CAPACITY, TONS PER SQ. FT. |
|---|---|
| SOFT CLAY | 1 |
| WET SAND OR FIRM CLAY | 2 |
| FINE, DRY SAND | 3 |
| HARD, DRY CLAY OR COARSE SAND | 4 |
| GRAVEL | 6 |

LOAD CARRYING CAPACITIES OF VARIOUS TYPES OF SOIL.



STANDARD DESIGN FOR A FOOTING IN A RESIDENTIAL CONSTRUCTION



FOOTING FOR CONCRETE FOUNDATION WITH KEY

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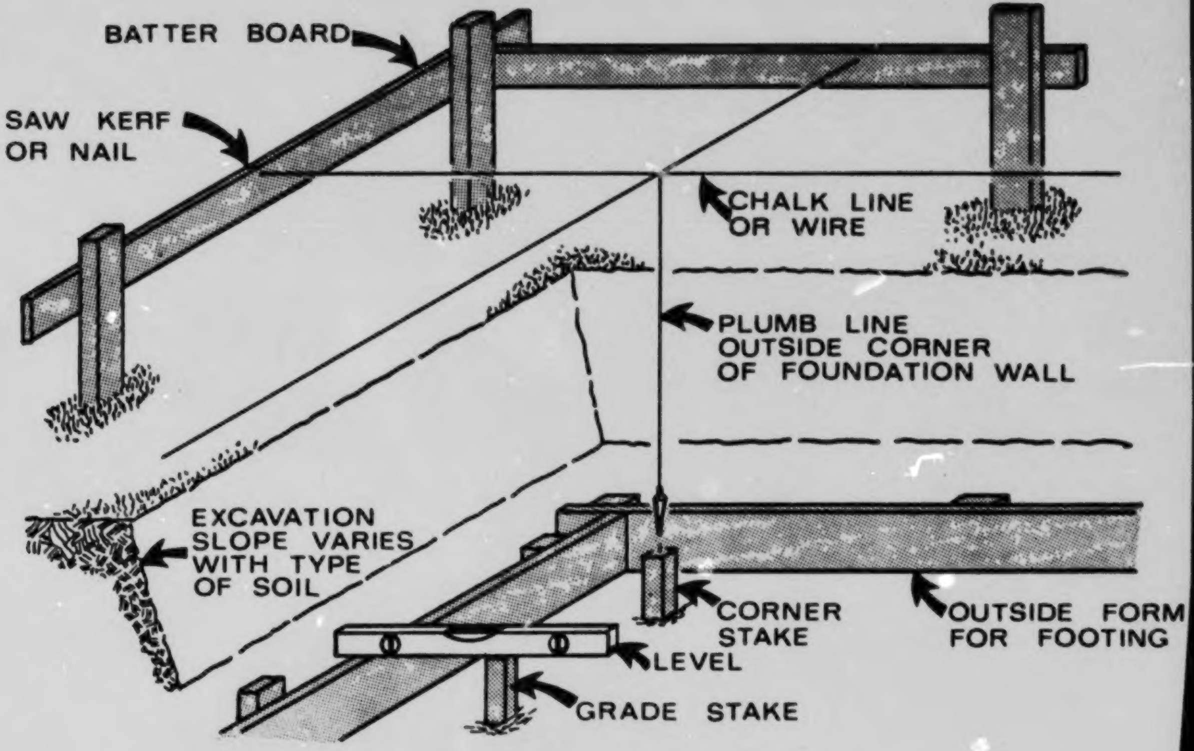
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

# LAYING OUT FORMS FOR FOOTING



THE OUTSIDE FORMS ARE BUILT FIRST

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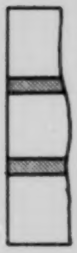
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY

IML-UMC

# MORTAR JOINTS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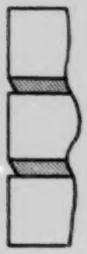
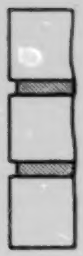

STRUCK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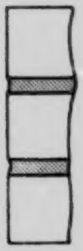
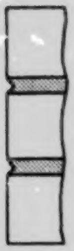
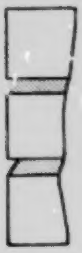
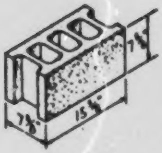

CONCAVE


V-JOINT

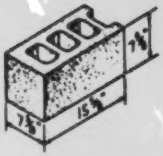

WEATHERED

COURTESY OF
MCGRAW HILL BOOK CO.
MATERIALS OF CONSTRUCTION BY
R.C. SMITH-1966

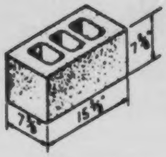
# SHAPES & SIZES OF TYPICAL CONCRETE MASONRY UNITS



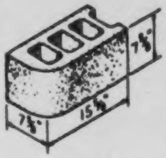
STRETCHER (3 CORE)



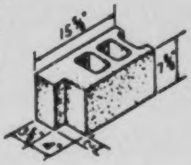
CORNER



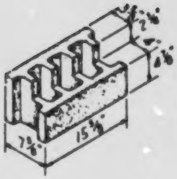
DOUBLE CORNER OR PIER



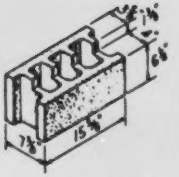
BULL NOSE



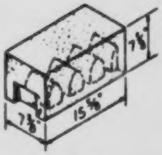
JAMB



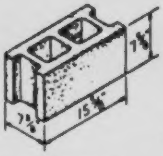
FULL CUT HEADER



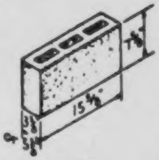
HALF CUT HEADER



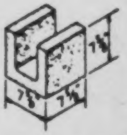
SOLID TOP



STRETCHER (2 CORE)



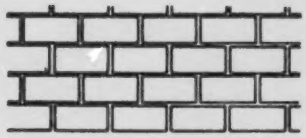
4" OR 6" PARTITION



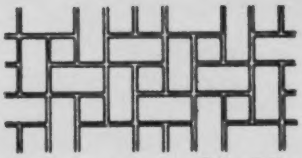
BEAM OR LINTEL

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

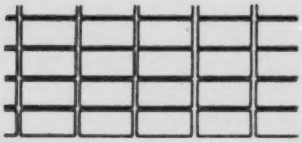
# BLOCK WALL PATTERNS



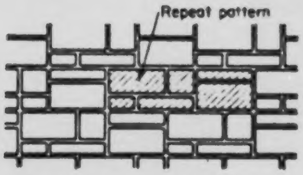
RUNNING BOND 8"x16"



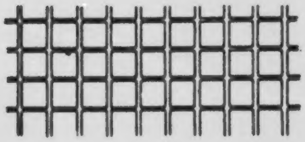
BASKET WEAVE 8"x8" & 8"x16"



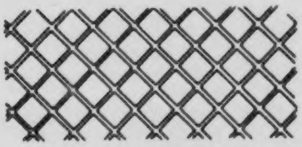
STACK BOND 8" x16"



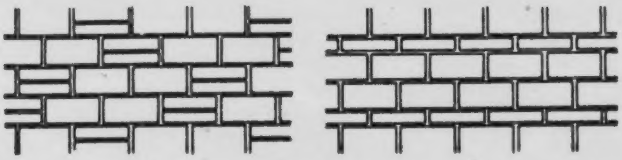
PATTERNED ASHLAR
4"x8", 4"x16", 8"x8", 8"x16"



STACK BOND 8"x8"



DIAGONAL STACKING 8"x8"



COURSED ASHLAR 4"x16" & 8"x16"

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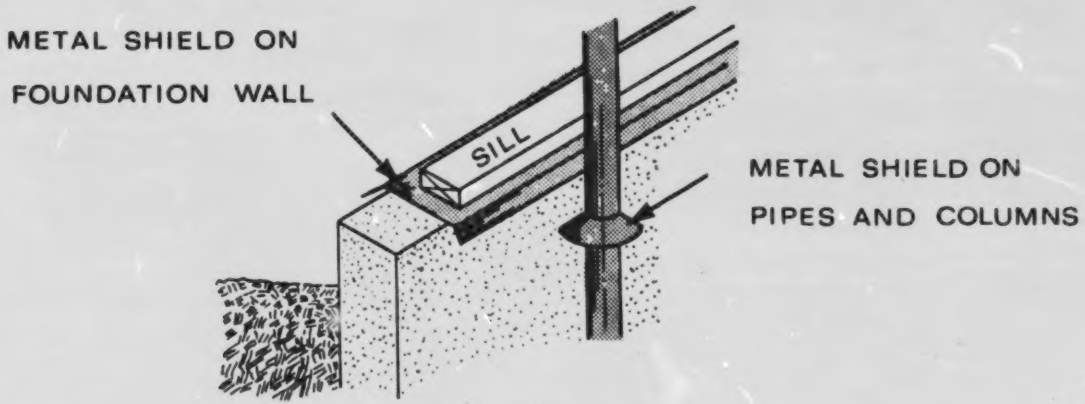
# TERMITE SHIELDS



COURTESY OF
GOODHEART-WILLCOX CO.
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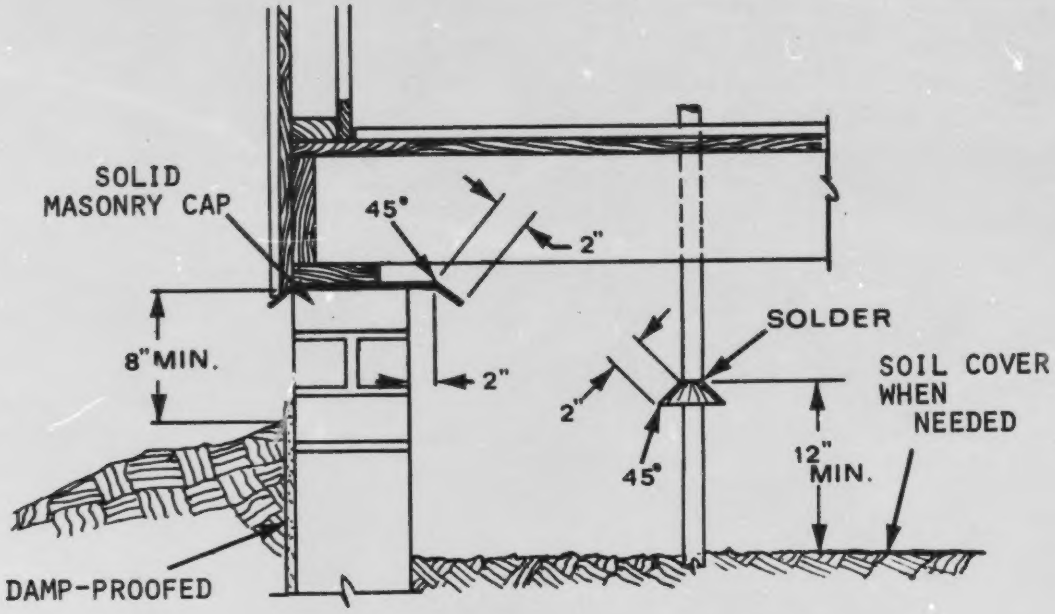
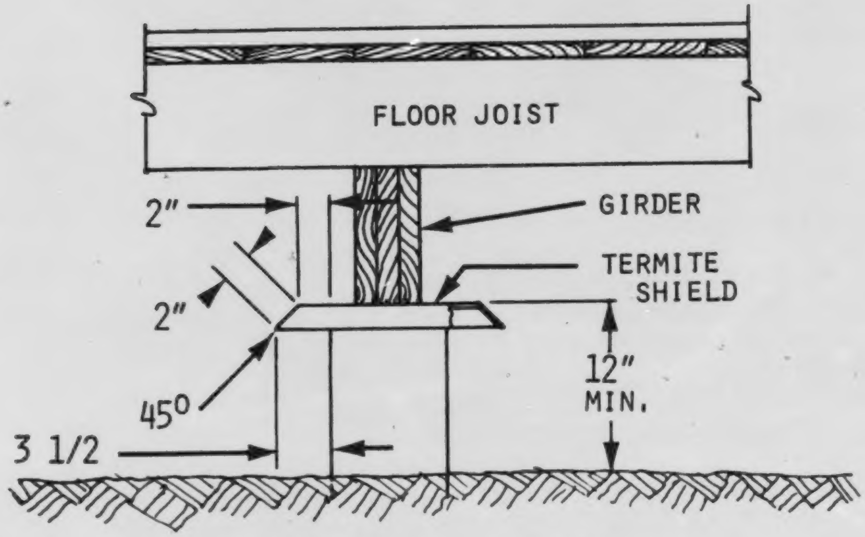
# INSTALLATION OF TERMITE SHIELDS



**AT EXTERIOR**



**OVER INTERIOR PIER**

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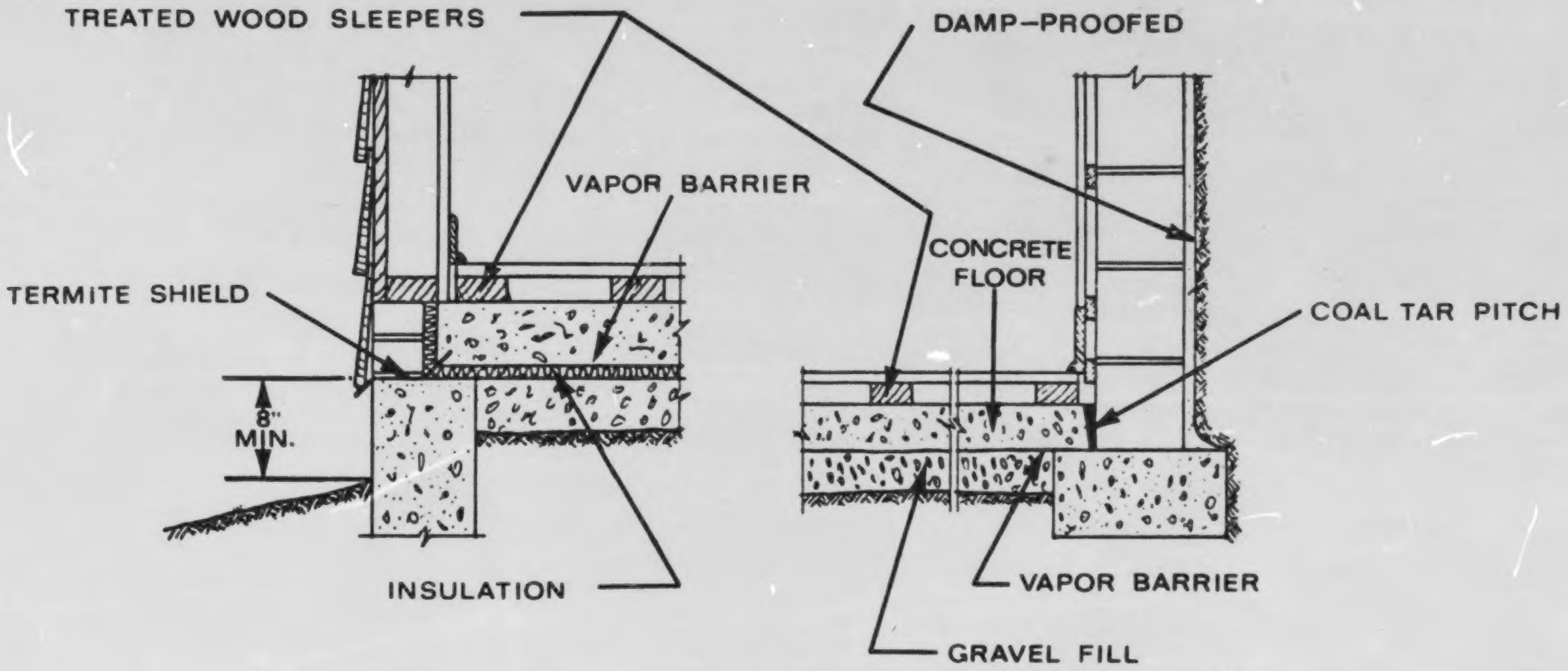
NATIONAL FOREST PRODUCTS ASSOC.
WASHINGTON, D.C.

# TERMITE BARRIERS FOR SLAB-ON-GROUND CONSTRUCTION



TERMITE SHIELD

FILLER AT JOINTS

3.1.0 - TM 8

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NATIONAL FOREST PRODUCTS ASSOC.
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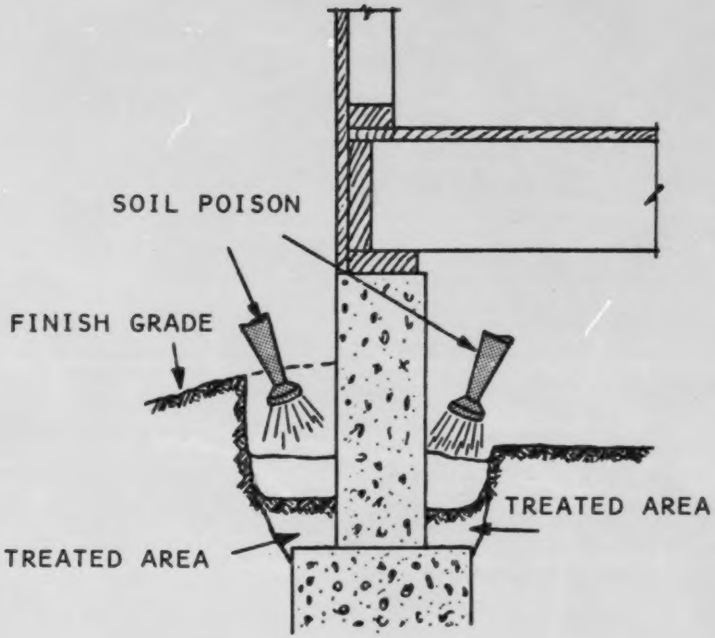
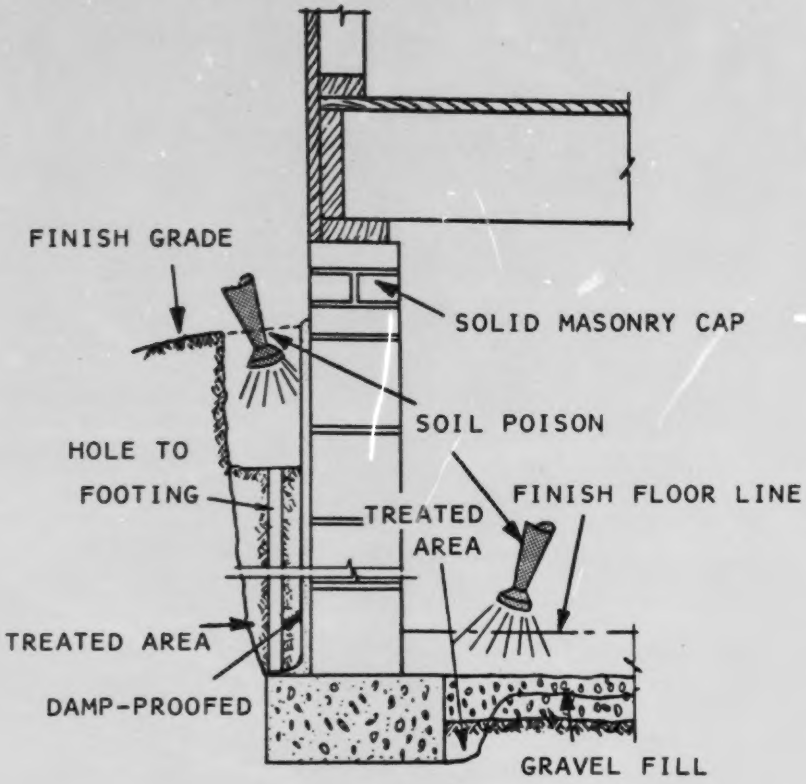
# APPLICATION OF CHEMICAL SOIL TREATMENT



POURED CONCRETE WALL & CRAWL SPACE



UNIT MASONRY WALL & BASEMENT

3.1.0 - TM 9

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## CRAW: SPACE CONSTRUCTION - CONCRETE BLOCK
## SECTION 3.1.0

## ASSIGNMENT SHEET #1 - EXCAVATION AND FOUNDATION FOOTING CONSTRUCTION

After studying the information in the references read each statement carefully and select the most nearly correct answer by placing the response letter in the space preceding the statement.

______1. It is common practice to establish excavation depth and consequently, the foundation elevation (height) by using:

a. the highest elevation on the primeter of the excavation as a control point.

b. the highest elevation on the site.

c. the lowest elevation on the perimeter of the excavation as a control point.

d. an average of the difference between the lowest and highest elevation on the perimeter of the excavation.

______2. The process of replacing earth around substructures or foundations is identified as:

a. rough grading.

b. finish grading.

c. backfilling.

d. compacting.

______3. Select the incorrect statement:

a. batter boards are placed so that the corner of the double batter board is at the exact point of the intersection of of the outside building lines.

b. footings are the widened sections of the foundation designed to increase the area of bearing surface.

c. in the northern parts of the U.S. the foundation should extend below the frost line.

d. footing and forms may consist of soil sides, the result of hand or machine excavation.

______4. In relation to concrete mix proportions, the ratio 1:2:4 means:

a. 1 bag of cement, 2 cu. ft. of sand, and 4 cu. ft. of gravel.

b. 1 cu. ft. of cement, 3 cu. yds. of sand, and 4 cu. yds. of aggregate.

c. 1 part cement, 2 parts sand and 4 parts gravel.

d. 1 part cement, 2 parts aggregates, and 4 parts water.

______5. Calculate the cubic yards of concrete needed to complete a foundation wall footing 8" x 16" with overall structure dimensions of 26' x 64'.

a. 212 cu. yds.

b. 5.9 cu. yds.

c. 6.7 cu. yds.

d. 20. cu. yds.

______6. The workability, setting properties and strength of a concrete mix are most affected by:

a. the ratio of the mix.

b. the humidity.

c. the number of times troweled.

d. the brand of cement used.

______7. The weight of 1 bag (1 cu. ft.) of Portland cement is:

a. 50 lbs.

b. 94 lbs.

c. 105 lbs.

d. 150 lbs.

______8. Generally most concrete can be poured:

a. from ready-mix trucks into the forms.

b. with very little aid of the workman.

c. without efforts to compact and consolidate the concrete mass.

d. in a large pile and distributed as needed.

______9. Trapped air along the form base causes:

a. honeycombing.

b. air-entrainment, a desirable property.

c. excessive pressure on the forms.

d. segregation of aggregates.

_____10. The primary purpose of covering concrete with a vapor barrier is to:

a. prevent surface damage.

b. prevent excessive moisture loss during the early stages of hardening.

c. maintain 70°F temperature

d. speed up the hydration process.

## CRAWL SPACE CONSTRUCTION - CONCRETE BLOCK
## SECTION 3.1.0

### ASSIGNMENT SHEET #2 - FOUNDATION WALL CONSTRUCTION, INSULATION, TERMITE CONTROL AND BACKFILLING

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

_____1. Parts of a concrete block

_____2. Isolated section or column of masonry

_____3. Condition of mortar that is readily handled with a trowel

_____4. Mixture of finely ground burned clay and limestone for making concrete or mortar

_____5. Mixed combination of Portland cement, lime and additives

_____6. A common type of tooled mortar joint

_____7. Of primary importance to the workability of mortar

_____8. The last concrete block to be layed in a particular course

_____9. A masonry column bonded to a masonry wall

_____10. A successful method of controlling termites

a. Portland cement

b. Water

c. Pilaster

d. Soil poisoning

e. Core, web, vertical and face shell

f. Masonry cement

g. Concave

h. Pier

i. Workability

j. Closure

# CRAWL SPACE CONSTRUCTION - CONCRETE BLOCK
## SECTION 3.1.0

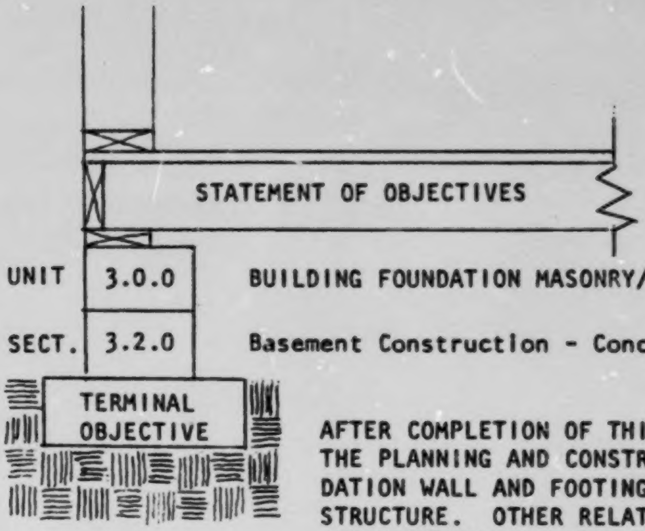
## ANSWERS TO ASSIGNMENT #1 AND #2

**Assignment #1**

1. a
2. c
3. a
4. c
5. b
6. a
7. b
8. a
9. a
10. b

**Assignment #2**

1. e
2. h
3. i
4. a
5. f
6. g
7. b
8. j
9. c
10. d



## STATEMENT OF OBJECTIVES

UNIT 3.0.0 **BUILDING FOUNDATION MASONRY/CONCRETE WALLS**

SECT. 3.2.0 Basement Construction - Concrete Foundation Wall

TERMINAL OBJECTIVE

AFTER COMPLETION OF THIS SECTION THE LEARNER WILL PERFORM THE PLANNING AND CONSTRUCTION OF A CONCRETE BASEMENT FOUNDATION WALL AND FOOTINGS FOR A SINGLE-FAMILY RESIDENTIAL STRUCTURE. OTHER RELATED ACTIVITIES INCLUDE WATER SERVICE INSTALLATION, CONTROL OF GROUND WATER, MATERIALS ESTIMATING, COMMERCIAL CONCRETE FORM INSTALLATION, BACKFILLING AND ROUGH GRADING.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

3.2.1 Employ a competent sub-contractor to excavate to a predetermined depth as indicated on the corner batter board stakes. The learner will check depths and serve as an assistant to the earth moving equipment operator.

3.2.2 Draw to scale a cross section view of a concrete foundation wall and footing recommended for use in the construction of a typical residence basement. Use Federal Housing Administration Minimum Property Standards as acceptable practice.

3.2.3 Name two techniques for preparing foundation wall and pier footing forms. Include materials, sizes and placement of form parts.

3.2.4 Layout and construct foundation wall footing forms and prepare earth footing forms by trenching into the soil to the specified width and depth.

3.2.5 Calculate the elevation for the top of the basement wall footing and the top of pier footings.

3.2.6 Locate and place leveling pins in the trenched footing forms at each wall intersection, spaced approximately eight feet on center and centered between the sides of the trench. Set leveling pin height by string or builders level.

3.2.7 List in writing the ingredients used to prepare concrete and the primary function of each.

3.2.8 Write the meaning of a concrete mix consistency of a "ratio of 1.2.4.".

3.2.9 Calculate the cubic yards of concrete needed for the foundation footings.

3.2.10 Place and level 5 bag redi-mix concrete in foundation wall and pier footing forms.

3.2.11 Layout location on the footings for the alignment of prefabricated form panels.

3.2.12 Assemble outside prefabricated form panels for concrete wall.

3.2.13 Assemble inside prefabricated form panels for concrete wall.

3.2.14 Install wall spreaders between the inside and outside wall forms.

3.2.15 Tie inside and outside wall forms together using form ties.

3.2.16 Install wales to inside wall forms.

3.2.17 Align wall forms using stakes and braces.

3.2.18 Install forms for all openings in foundation walls.

3.2.19 Place 5 bag redi-mix concrete in basement wall forms.

NOTE: SPADE ALONG BOTH SIDES OF THE FORMS TO ELIMINATE HONEYCOMBING.

3.2.20 Install 1/2 inch anchor bolts in top of foundation wall spaced not more than four (4) feet apart.

3.2.21 After one (1) to two (2) days of curing, remove the wall forms and oil if necessary.

3.2.22 Layout and install ground water control system consisting of drain tile laid adjacent to the outside edge of the wall footing and a sump basin to allow water to collect for disposal by a pump.

3.2.23 Waterproof basement walls below finished grade to specifications listed in the Federal Housing Administration Minimum Property Standards for one or two living units.

3.2.24 Install pressed steel areaways for basement windows that are located below the finished grade.

3.2.25 Employ a competent sub-contractor to backfill and rough grade the excavation outside the basement walls after a minimum one (1) week curing period.

3.2.26 Locate public water main, layout location of trench to service access (in basement wall) excavate trench to depth required by local plumbing code, and employ sub-contractor to install water service and meter housing.

> NOTE: WATER METER HOUSING INSTALLATION ARE COMPLETED BY CITY EMPLOYEES IN SOME COMMUNITIES. WATER AND SEWER TAPS ARE GENERALLY SUPERVISED OR PERFORMED BY WATER DEPARTMENT EMPLOYEES.

## INSTRUCTIONAL FORMAT

UNIT 3.0.0 **BUILDING FOUNDATION MASONRY/CONCRETE WALLS**

SECT. 3.2.0 **Basement Construction - Concrete Foundation Wall**

### INSTRUCTIONAL PROCEDURES

**Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.**

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local construction business firms that specialize in the sale of earth moving equipment, masonry materials and supplies, redi-mix concrete, water and sewer service, and termit protection service for supplemental information related to foundation construction.

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

1. TM 1 - Footing (See 3.1.0 - TM 1)
2. TM 2 - Footing With Key Formed By Wooden Stays
3. TM 3 - Laying Out Forms For Footing (See 3.1.0 - TM 2)
4. TM 4 - Preparation and Procedures For Placing Concrete
5. TM 5 - Preparation and Procedures For Placing Concrete (con't)
6. TM 6 - Reusable Panels
7. TM 7 - Using a Precut Spreader
8. TM 8 - Ties and Clamps
9. TM 9 - Patented Wall Tie
10. TM 10 - Termit Shields (See 3.1.0 - TM 6)
11. TM 11 - Installation of Termite Shields (See 3.1.0 - TM 7)
12. TM 12 - Application of Chemical Soil Treatment (See 3.1.0 - TM 9)

D. Assignment sheet #1 - Foundation Wall Forming

E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Kicklighter, Clois E. Modern Masonry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1977.

C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Comapny, Inc., 1976.

## BASEMENT CONSTRUCTION - CONCRETE FOUNDATION WALL
## SECTION 3.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Excavation procedures

   A. Mechanical equipment

      1. Bulldozer

      2. Back hoe

      3. End loader

      4. Combined use of equipment

      5. Cost

   B. Placement of soil

      1. Top soil

      2. Sub soil

      3. Disposal of excess soil

II. Footing design

   A. Types

      1. Rectangular

      2. Flared

      3. Stepped

   B. Sizes

      1. FHA minimum width

         a. One story basementless (wall thickness + 2" Projection)

         b. Two story basementless (wall thickness + 3" projection)

         c. One story basement (wall thickness + 3" projection)

         d. Two story basement (wall thickness + 4" projection)

      2. FHA minimum thickness (6")

- C. Keyed footings

- III. Basement foundation wall footing
  - A. Height factors
    - 1. Frost level
    - 2. Clearance height inside
    - 3. Datum
    - 4. Surface drainage
    - 5. Driveway slope
    - 6. Finish grade
    - 7. Window size
    - 8. Sub-soil drainage
    - 9. Floor drainage
  - B. Footing elevation calculations
    - 1. Top elevation
    - 2. Bottom elevation
  - C. Leveling trenched footings

- IV. Concrete mix ingredients
  - A. Cement
  - B. Sand
  - C. Aggregate
  - D. Water
  - E. Proportions
    - 1. 1 - Cement
    - 2. 3 - Sand
    - 3. 4 - Rock

4. 2.5 to 3 gal. water

a. Field conditions

b. Strength factor

V. Calculating quantities of concrete

A. Cubic yard method

B. Estimating table

1. Sq. ft. area one av. yd. will fill

2. Example: 4" + thickness will fill 81 sq. ft.

VI. Placing and leveling concrete in footing forms

A. Transportation methods

1. Ready-mix truck

2. Wheelbarrow

B. Leveling

1. Forms

2. Pins

C. Floating

D. Finishing

E. Curing

VII. Wall forms

A. Basic consideration common to wall forming systems

1. Joint tightness

2. Alignment

3. Strength requirements

        4. Pressures
            a. Concrete weight (150 lbs. per. cu. ft.)
            b. Location of pressures
    B. Construction practices
        1. Low wall forms (up to 3')
        2. High wall forms (4' and over)
        3. Form ties and spreaders
            a. Snap ties
            b. Coil type
    C. Prefabricated panel forms
        1. Wood
        2. Metal
        3. Surface treatment
    D. Form alignment
        1. Installation of wales
        2. Staking and bracing
    E. Wall opening forms
        1. Windows
        2. Doors
        3. Utility pipes

VIII. Placing concrete in wall forms
    A. Segregation avoidance
    B. General placement practices (6" to 12" layers)
    C. Compaction techniques
    D. Anchor bolt placement

E. Curing time

F. Stripping

IX. Waterproofing basement walls

A. Ground water drainage systems

1. Location

2. Sump basin

3. Gravity drainage

4. Types of drain pipes

5. Gravel or stone fill

B. Methods

1. Cement plaster (block walls)

2. Asphalt waterfroofing (concrete walls)

3. Membrane film and asphalt coating

X. Backfilling and rough grading

A. Equipment

1. Bulldozer

2. Endloader

3. Back hoe

4. Grading tractor

B. General practices

1. Curing time (1 week minimum)

2. Soil condition

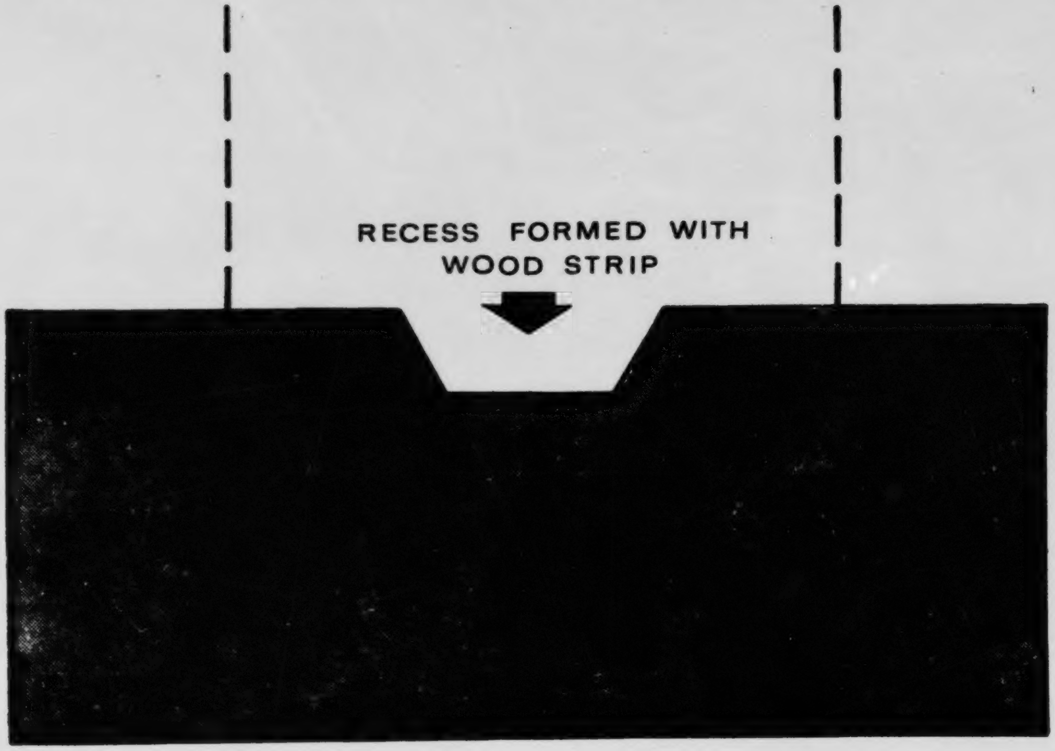
3. Wall strength

4. Obstructions

XI. Water service

- A. Sources
- B. Trenching
  - 1. Width
  - 2. Depth
- C. Meter location
- D. Types of water line piping
  - 1. Galvanized steel pipe
  - 2. Copper tubing
  - 3. Plastic pipe
  - 4. Code requirements

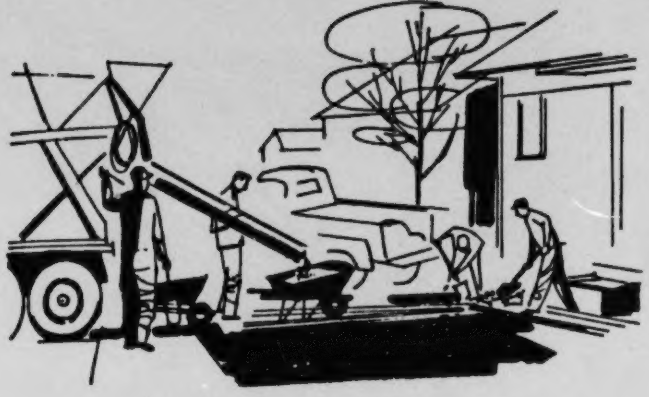
# FOOTING WITH KEY FORMED BY WOODEN STRIP



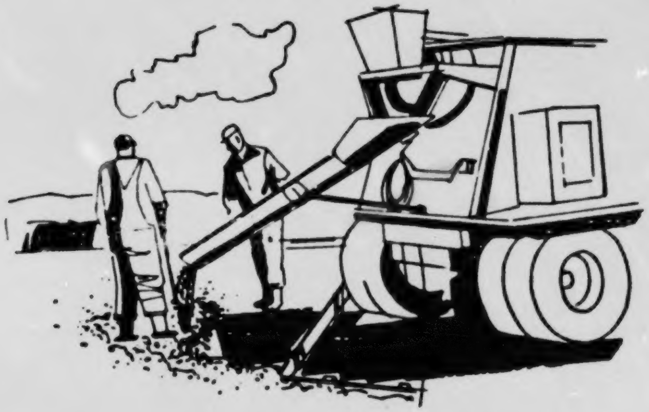
COURTESY OF GOODHEART-WILLCOX CO., MODERN CARPENTRY, IML-UMC

# PREPARATION & PROCEDURE FOR PLACING CONCRETE

HAVE FORMS WELL BRACED



HAVE WHEELBARROWS HANDY



HAVE SUBGRADE DAMPENED

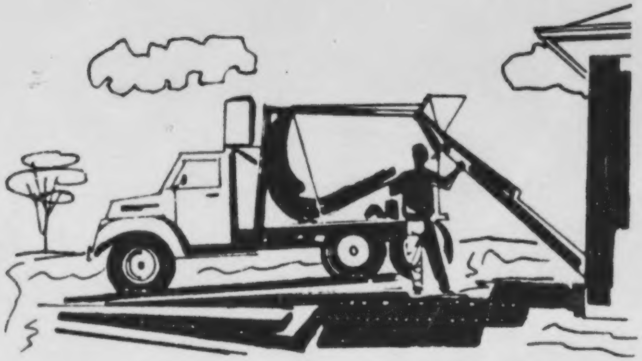
HAVE STRIKE-OFF BOARDS
READY AND SCREEDS IN
PLACE

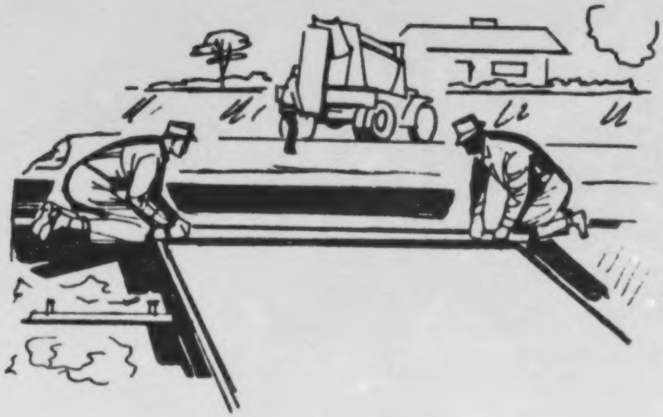
3.2.0 - TM 4

COURTESY OF:
PORTLAND CEMENT ASSOCIATION

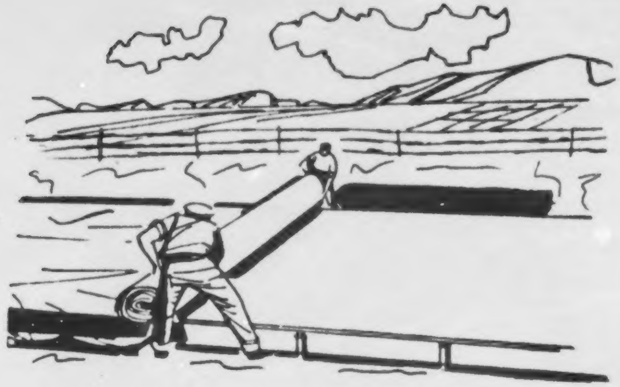
IML-UMC

# PREPARATION AND PROCEDURE FOR PLACING CONCRETE


HAVE PLANKS AND RUNWAYS IN PLACE


HAVE STRAIGHTEDGE READY

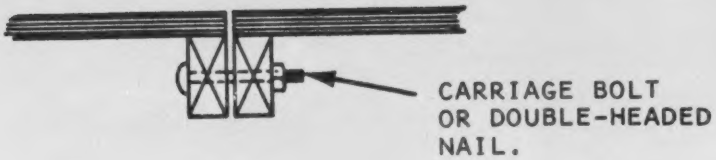
HAVE VIBRATION EQUIPMENT READY


HAVE CURING MATERIALS READY

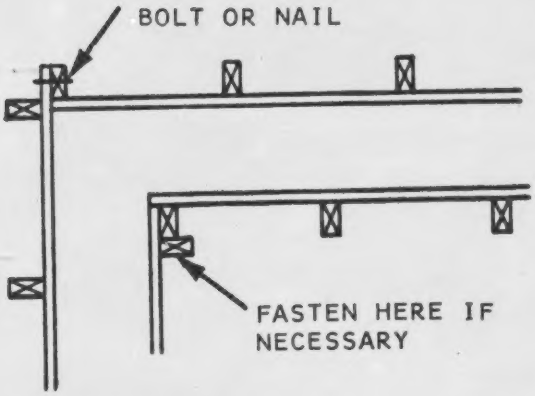
COURTESY OF:
PORTLAND CEMENT ASSOCIATION

IML-UMC

# REUSABLE PANELS



JOINING PANELS IN LINE

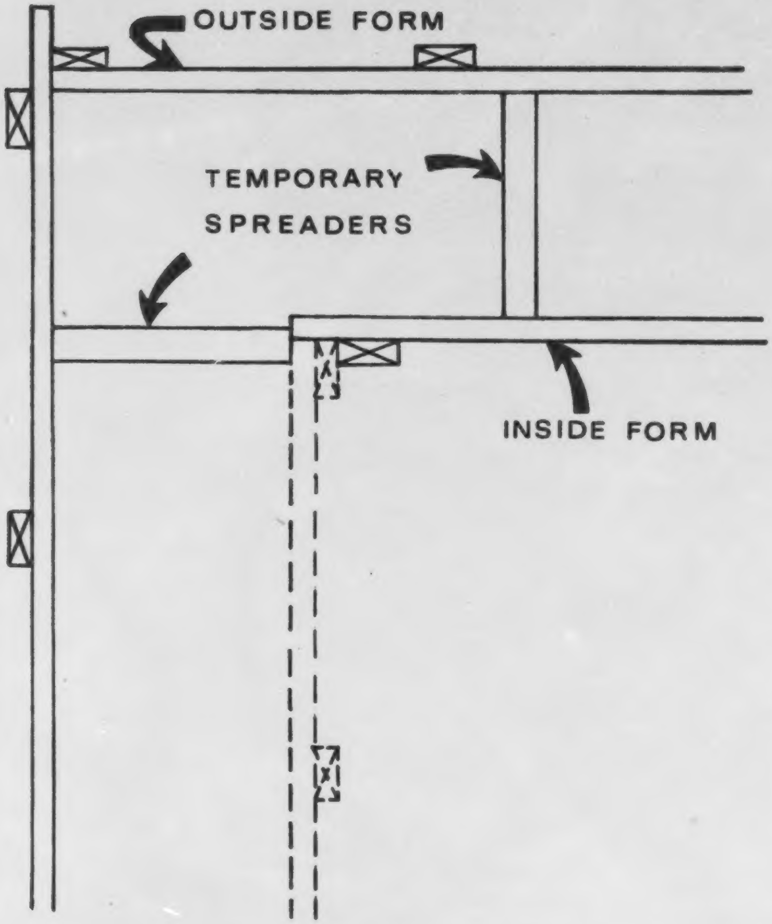


JOINING FORM PANELS AT CORNERS

METHODS OF ATTACHING FORM PANELS CONSTRUCTED OF PLYWOOD AND 2 X 4 STUDS.

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
IML-UMC

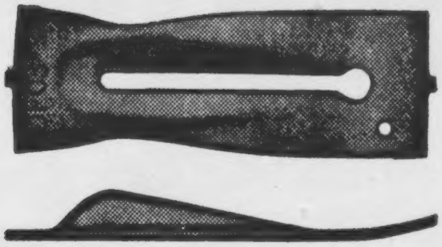
# USING A PRECUT SPREADER



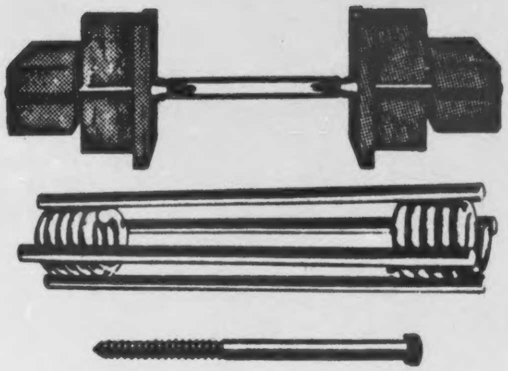
COURTESY OF:
GOODHEART-WILLCOX COMPANY, INC.
MODERN CARPENTRY

IML-UMC

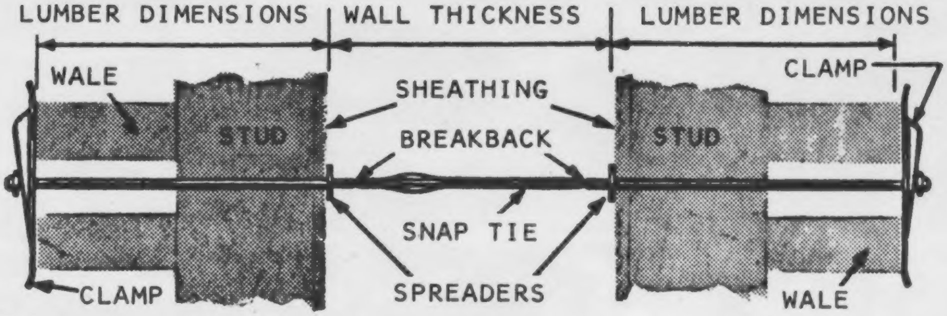
# TIES & CLAMPS



WALL TIE CLAMP



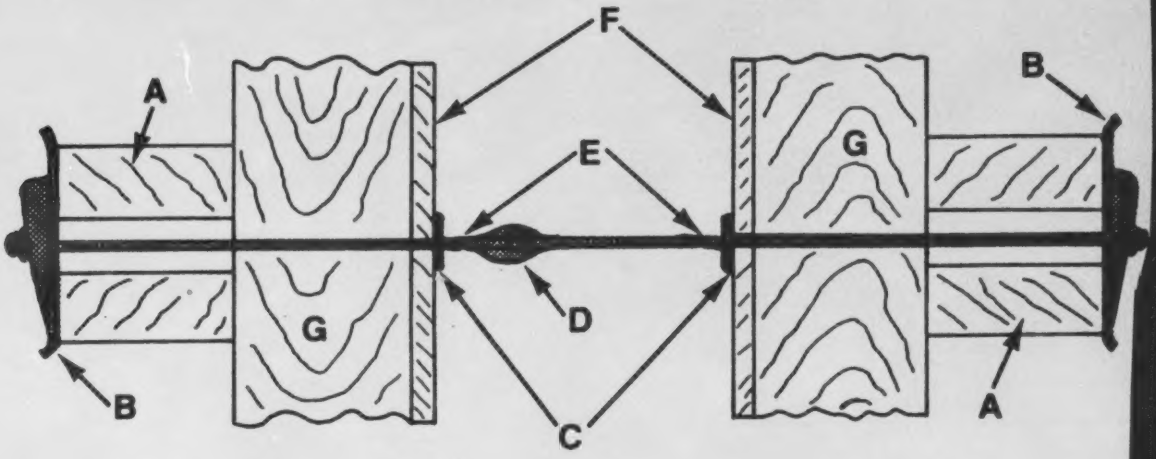
TOP: HEAVY DUTY WALL TIE ASSEMBLY
CENTER: INTERNAL MEMBER
BELOW: LAG SCREW



USE OF A PATENTED WALL TIE

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
IML-UMC

# PATENTED WALL TIE



F 1. Sheathing

C 2. Spreaders

G 3. Stud

A 4. Wale

E 5. Breakback

B 6. Clamp

D 7. Snap tie

## BASEMENT CONSTRUCTION - CONCRETE FOUNDATION WALL
## SECTION 3.2.0

### ASSIGNMENT #1 - FOUNDATION WALL FORMING

After studying the information in the references, read each statement carefully and select the most nearly correct answer by placing the response letter in the space preceding the statement.

_____1. Devices used to prevent the forms from spreading when the concrete is placed are:

a. ties.
b. wales.
c. braces.
d. studs.

_____2. Forms are kept in correct position with:

a. braces.
b. wales.
c. ties.
d. studs.

_____3. A type of forming system which is assembled much like a frame wall is called:

a. panel forming.
b. built-in-place forming.
c. braced forming.
d. vertical forming.

_____4. What is the purpose of wales?

a. they keep the forms in place.
b. they stiffen the plywood sheets, keep them in line and provide support for the ties.
c. they keep the concrete in a plastic state until it fully sets.
d. they are used in the construction of footings.

_____5. Forms which can be erected quickly by fewer men, can be reused a great many times, and are very durable are:

a. built-in-place forms.
b. patented, manufactured forms.
c. footing forms.
d. keyed forms.

_____6. A device that passes through both sides of a form, retaining them against the lateral pressure of the concrete is a:

a. form tie,
c. spreader.
b. wale,
d. concrete anchor.

_____7. A spreader is used:

a. never.

b. between the inner faces of the forms in order to keep them separated to the exact width of the wall.

c. in the event that the concrete does not exert enough pressure on the form walls,

_____8. Many snap ties do not require the use of spreaders because:

a. the degree of difficulty in inserting them is too great

b. the spacing is automatically set by the position of the clamp.

c. the ties make it almost impossible to remove the spreaders when the concrete is poured.

_____9. Plywood panels are usually given a coat of oil so that:

a. they won't shrink,

b. they won't absorb moisture from the concrete,

c. the will separate from the hardened wall without difficulty,

d. they will leave the outer surface of the concrete wall smooth.

_____10. Which of the following is true?

a. the concrete is leveled along the top edges of the forms.

b. sometimes the height to which the concrete is leveled inside the forms is marked with double-headed nails.

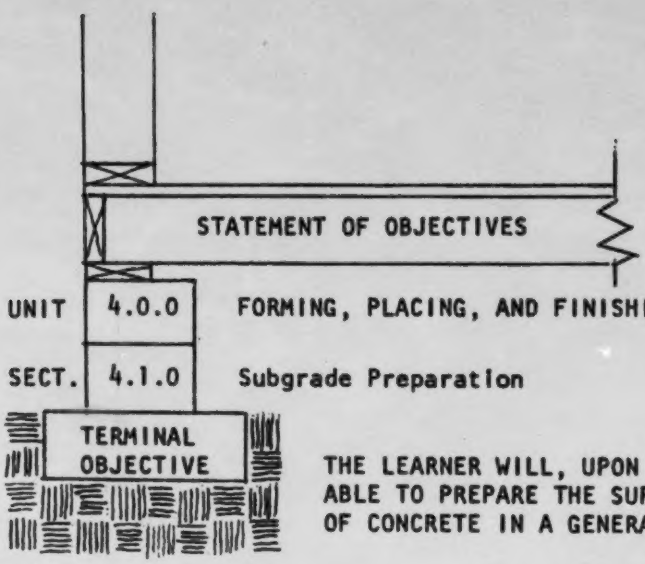
c. the concrete adequaltely seeks its own level when vibrated so that further working of the concrete is not necessary.

d. the surface of the concrete does not need to be as perfectly level as possible, since it is impossible to find a perfectly straight sill,

# BASEMENT CONSTRUCTION - CONCRETE FOUNDATION WALL
## SECTION 3.2.0

## ANSWERS TO ASSIGNMENT #1

1. a
2. a
3. a
4. b
5. b
6. a
7. b
8. d
9. c
10. b



## STATEMENT OF OBJECTIVES

**UNIT 4.0.0** FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

**SECT. 4.1.0** Subgrade Preparation

**TERMINAL OBJECTIVE**

THE LEARNER WILL, UPON COMPLETION OF THIS SECTION, BE ABLE TO PREPARE THE SUPPORTING SUBGRADE FOR PLACEMENT OF CONCRETE IN A GENERAL HORIZONTAL POSITION.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

4.1.1 Compact the supporting soil (subgrade) to a soil density equal to or greater than undisturbed soil.

4.1.2 List four (4) granular fills recommended to bring the subgrade to uniform bearing and final grade by the Portland Cement Association.

4.1.3 Identify three (3) methods that may be used to compact subgrades prior to forming and placing concrete.

4.1.4 State the correct condition of the subgrade in relation to moisture content immediately prior to placing concrete.

## INSTRUCTIONAL FORMAT

UNIT 4.0.0 **FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL**

SECT. 4.1.0 Subgrade Preparation

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of state and local road conctruction firms, city engineering department and local ready-mix concrete firms specializing in concrete street construction

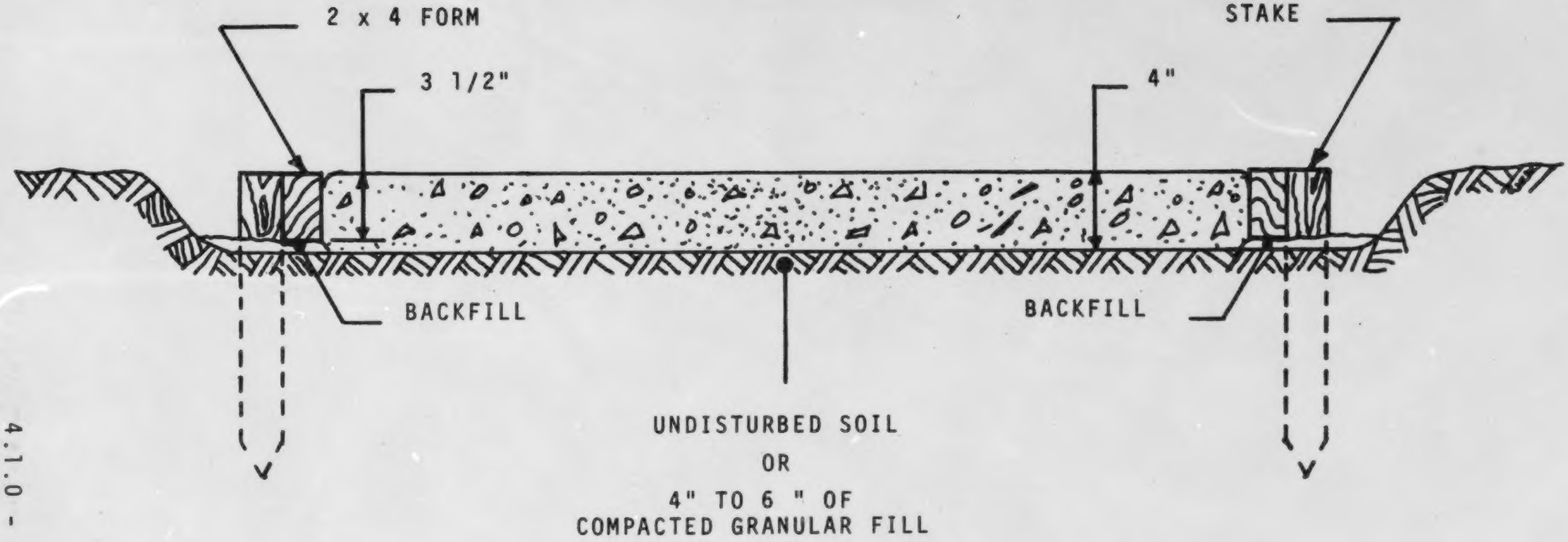
III. Instructional materials used in this section

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Typical Driveway or Sidewalk Subgrade
- D. Assignment sheet #1 - Subgrade Preparation
- E. Answers to assignment sheet #1

IV. References:

- A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A Bennett Company, Inc., 1976.
- B. Portland Cement Association. "Cement Mason's Guide To Building Concrete Walks, Drives, Patios and Steps". Skokie, Illinois: Portland Cement Association, 1971, 3rd. Printing 1974.
- C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# TYPICAL DRIVEWAY OR SIDEWALK SUBGRADE



# SUBGRADE PREPARATION
## SECTION 4.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Subgrade conditioning

  A. Purpose

  B. Condition requirements

    1. Compaction

    2. Removal of organic matter

    3. Fill uniformity

    4. Moisture content

    5. Sandy soil

II. Granular fills

  A. Purpose

  B. Granular materials

    1. Sand

    2. Gravel

    3. Crushed stone

    4. Slag

III. Compaction techniques

  A. Purpose

  B. Layer thickness

  C. Extension of subgrade

- D. Compaction methods
    - 1. Hand tampers
    - 2. Rollers
    - 3. Vibrators
- IV. Moisture content of subgrade
    - A. Uniformity
    - B. Unsuitable conditions
        - 1. Free standing water
        - 2. Muddy or soft spots

## SUBGRADE PREPARATION
## SECTION 4.1.0

### ASSIGNMENT #1 - SUBGRADE PREPARATION

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

______1. Soil that has been compacted to support concrete slabs or structure.

______2. Grass, roots and sod that must be removed prior to placing concrete.

______3. A commonly used granular fill.

______4. A compaction tool.

______5. Causes of light and dark spots in the concrete finish.

______6. Maximum thickness of fill layer before compaction is performed.

______7. Possible results of poorly compacted subgrade.

______8. A vapor barrier sometimes placed over the subgrade and directly beneath the concrete.

______9. Used as fill under concrete if excess moisture and frost action is expected.

______10. Prevents rapid loss of water from concrete flatwork.

a. Sand

b. Moisture content of subgrade

c. Six inches

d. Cracks

e. Polyethylene film

f. Coarse granular fill

g. Moisten subgrade

h. Roller

i. Subgrade

j. Organic matter

## SUBGRADE PREPARATION
## SECTION 4.1.0

## ANSWERS TO ASSIGNMENT #1

1. i
2. j
3. a
4. h
5. b
6. c
7. d
8. e
9. f
10. g

## STATEMENT OF OBJECTIVES

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

SECT. 4.2.0 Formwork

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL CONSTRUCT STRAIGHT AND CURVED FORMS FOR THE PURPOSE OF PLACING AND FINISHING CONCRETE FLATWORK GENERALLY ASSOCIATED WITH THE CONSTRUCTION OF RESIDENTIAL STRUCTURES.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

4.2.1 Identify two (2) kinds of materials generally used for construction of forms for the purpose of placing concrete in a horizontal position.

4.2.2 Set straight drive, walk, and patio side forms to the proper grade by use of a string line.

4.2.3 Stake and brace side forms to horizontal and vertical alignment.

4.2.4 List four (4) materials used to form horizontal curves in concrete form construction.

4.2.5 Construct horizontal curved concrete forms as specified by the Portland Cement Association.

4.2.6 Install premolded strips of isolation joint materials as specified by the Portland Cement Association.

## INSTRUCTIONAL FORMAT

**UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL**

**SECT. 4.2.0 Formwork**

## INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

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B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local labor organizations or apprenticeship training schools that provide apprenticeship training opportunities for the apprentice carpenter

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

1. TM 1 - Typical Framing Details for Concrete Driveway or Sidewalk (See 4.1.0 - TM 1)

D. Assignment sheet #1 - Horizontal Form Construction Practices

E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Portland Cement Association. "Cement Mason's Guide To Building Concrete Walks, Drives, Patios and Steps". Skokie, Illinois: Portland Cement Association, 1971, 3rd. Printing 1974.

C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# FORM WORK
## SECTION 4.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Introductory information
   - A. Form material standards
   - B. Horizontal and vertical alignment
   - C. Method of setting forms

II. Material needs
   - A. Sizes of form lumber
     - 1. 4" slab thickness
     - 2. 5" slab thickness
     - 3. 6" slab thickness
   - B. Dressed lumber sizes
     - 1. Thickness
     - 2. Width
   - C. Wood Stakes
     - 1. Purpose
     - 2. Placement interval
       - a. 2" lumber
       - b. 1" lumber
     - 3. Thickness and width sizes
     - 4. Stake length
   - D. Steel stakes
     - 1. Advantages
       - a. Reusable
       - b. Driving and pulling easier

2. Disadvantages

a. Require volume work

b. More expensive

c. Storage

III. Forming horizontal curves

A. Materials

1. 1" lumber

2. 1/4 to 1/2 in. thick plywood

3. Hardboard

4. Sheet metal

B. Bending techniques

1. Flexible material

2. Saw kerfing

C. Stake placement

IV. Permanent forms

A. Purpose

B. Materials

C. Anchoring techniques

V. Isolation joints

A. Purpose

B. Materials

C. Placement techniques

## FORM WORK
## SECTION 4.2.0

### ASSIGNMENT #1 - HORIZONTAL FORM CONSTRUCTION PRACTICES

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

______1. The slope of a finished site or slab

______2. A line laid between stakes to indicate the shape and elevation of flatwork or structure

______3. Type of nail recommended for easy form removal

______4. A method of keeping forms in position

______5. Lumber used for form work that is surfaced in a planing machine to attain smoothness and uniformity of size

______6. Placement interval for form stakes on straight installation

______7. Technique for bending 2 inch thick side form materials

______8. Placement interval for form stakes on curved installation

______9. Wood side forms and divider strips left in place for decorative and/or control joint purposes

_____10. A separation in concrete work used to keep sections of concrete or structure apart

a. Double headed

b. Bracing

c. 4 ft.

d. Saw kerfing

e. Permanent forms

f. Isolation joint

g. 2 to 3 ft.

h. Grade

i. Dressed

j. String line

# FORM WORK
# SECTION 4.2.0

## ANSWERS TO ASSIGNMENT #1

1. h
2. j
3. a
4. b
5. i
6. c
7. d
8. g
9. e
10. f

## STATEMENT OF OBJECTIVES

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

SECT. 4.3.0 Concrete Requirements

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL CALCULATE THE NUMBER OF CUBIC YARDS OF CONCRETE FOR A SPECIFIC JOB AND WRITE AN ORDER FOR THE CONCRETE WHICH INCLUDES SPECIFICATIONS FOR THE CONCRETE MIX.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

4.3.1 Calculate the number of cubic yards of concrete needed for a specific driveway or walk. Add five (5) percent for losses due to uneven subgrade and spillage. Calculation must be accurate to two decimal places.

4.3.2 Write and order for the amount of concrete needed for the job outlined in objective 4.3.1. Specifications are to be listed relative to: (1) maximum size aggregate, (2) minimum cement content, (3) maximum slump (4) compressive strength at twenty-eight (28) days, and (5) air content.

## INSTRUCTIONAL FORMAT

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

SECT. 4.3.0 Concrete Requirements

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

  A. Provide learner with statement of objectives sheet

  B. Discuss terminal and specific objectives

  C. Provide learner with instruction sheets for use with this section

  D. Explain evaluation procedures

II. Suggested instructional methods:

  A. Demonstration - to show manipulative operations at construction site

  B. Discussion - to encourage question and answer activities

  C. Team assignment - to enhance personal relationships in the work environment.

  D. Illustrated lecture - to introduce a lesson or focus attention

  E. Field trips - to illustrate construction techniques and application of materials

  F. Consultant - representatives of state and local construction firms, city engineering department and local ready-mix concrete firms.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  1. TM 1 - Formula - Estimating Cubic Yards of Concrete
  2. TM 2 - Table - Estimating Cubic Yards of Concrete for Slabs
  3. TM 3 - Specifications Table for Ordering Ready Mixed Concrete
  4. TM 4 - Mold for Slump Test
- D. Assignment sheet #1 - Material Estimating
- E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Portland Cement Association. "Cement Mason's Guide To Building Concrete Walks, Drives, Patios and Steps". Skokie, Illinois: Portland Cement Association, 1971, 3rd. Printing 1974.

C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# CONCRETE REQUIREMENTS
## SECTION 4.3.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Concrete volume calculations

  A. Mathematical formula method

    1. $\text{Cu. yds.} = \dfrac{\text{width} \times \text{length} \times \text{thickness in feet}}{27}$

    2. Cost = Cu. yds. x cost per cu. yd.

  B. Table estimates

    1. Contents

      a. Thickness in inches

      b. Area in square feet

      c. Cubic yds.

II. Specifications

  A. Aggregate

    1. Aggregate materials

    2. Maximum size

      a. Formula - 1/3 ST

      b. Aggregate sizes (see TM 3)

  B. Cement

    1. Relationship to aggregate size (see TM 3)

    2. Minimum content

  C. Slump

    1. Maximum 4 inches

    2. Disadvantages of wet, soupy mixes

D. Compressive strength at 28 days

  1. Minimum (see TM 3)

  2. Higher strength requirements

E. Air content

  1. Volume by percent

  2. Protection purposes

    a. Durability under freeze-thaw conditions

    b. Use of de-icing salts

  3. Non-protective purposes

    a. Reduces bleeding

    b. Reduces segregation

    c. Workability improvement

    d. Finishability improvement

# ESTIMATING CONCRETE

$$\text{CUBIC YARDS} = \frac{\text{WIDTH X LENGTH X THICKNESS}}{27}$$

EXAMPLE

BASEMENT FLOOR

4 INCH THICK

30 FEET WIDTH

42 FEET LENGTH

$$\text{CUBIC YARDS} = \frac{30 \times 42 \times .33}{27} = 15.4 \text{ CUBIC YARDS}$$

# ESTIMATING CONCRETE - SLABS

| | AREA IN SQUARE FEET (WIDTH X LENGTH) | | | | | |
|---|---|---|---|---|---|---|
| THICKNESS, IN. | 10 | 25 | 50 | 100 | 200 | 300 |
| 4 | 0.12 | 0.31 | 0.62 | 1.23 | 2.47 | 3.70 |
| 5 | 0.15 | 0.39 | 0.77 | 1.54 | 3.09 | 4.63 |
| 6 | 0.19 | 0.46 | 0.93 | 1.85 | 3.70 | 5.56 |

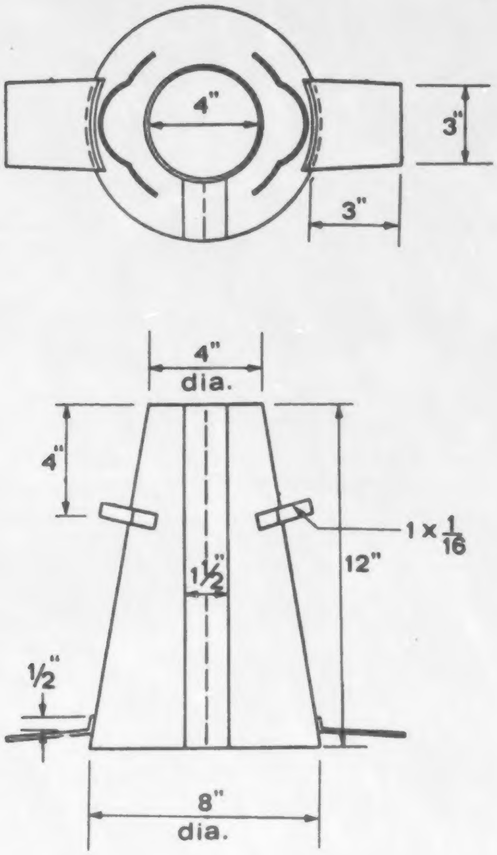
DOES NOT ALLOW FOR LOSSES DUE TO UNEVEN SUBGRADE, SPILLAGE, ETC. ADD 5 TO 10 PERCENT FOR SUCH CONTINGENCIES.

# ORDERING CONCRETE

| MAXIMUM-SIZE AGGREGATE, IN. | MINIMUM CEMENT CONTENT LB. PER CU. YD. | MAXIMUM SLUMP, IN. | COMPRESSIVE STRENGHT AT 28 DAYS LB. PER SQ. IN. | AIR CONTENT PERCENT BY VOLUME |
|---|---|---|---|---|
| 3/8 | 610 | 4 | 3,500 | 7 1/2 ± 1 |
| 1/2 | 590 | 4 | 3,500 | 7 1/2 ± 1 |
| 3/4 | 540 | 4 | 3,500 | 6 ± 1 |
| 1 | 520 | 4 | 3,500 | 6 ± 1 |
| 11/2 | 470 | 4 | 3,500 | 5 ± 1 |

IN ADDITION TO THE NUMBER OF CUBIC YARDS REQUIRED, THE READY MIX PRODUCER WILL NEED TO KNOW WHERE AND WHEN TO DELIVER THE CONCRETE. IF POSSIBLE, THE ORDER SHOULD BE PLACED AT LEAST A DAY AHEAD OF TIME.

# MOLD FOR SLUMP TEST



COURTEST
COURTESY OF:
PORTLAND CEMENT ASSOCIATION

IML-UMC

## CONCRETE REQUIREMENTS
## SECTION 4.3.0

### ASSIGNMENT #1 - MATERIAL ESTIMATING

After studying the information in the references, calculate the cubic yards of concrete needed to complete the following residential construction needs. Use decimal carried to two (2) places. (Do not include waste percentage until requested in item 10).

_________1. Concrete footing, 16 in. wide x 192 ft. long (total perimeter) x 8 in. thick.

_________2. Garage floor, 24 ft. wide x 24 ft. long x 4 in. thick.

_________3. Front entrance porch, 4 ft. wide x 5 ft. long x 4 in. thick.

_________4. Rear entrance porch, 4 ft. wide x 4 ft. long x 4 in. thick.

_________5. Front entrance step, 16 in. wide x 4 ft. long x 7 in. thick.

_________6. Garage entrance step, 14 in. wide x 3 ft. long x 6 in. thick.

_________7. Driveway, 24 ft. x 42 ft. x 4 in. thick.

_________8. Entrance side walk, 3 ft. x 13 ft. x 4 in. thick.

_________9. Total cu. yds. needed.

_________10. Plus 5% extra for slight varations in forming and sub base leveling.

_________11. Total cu. yds. needed.

_________12. Total cost at $40.00 per cubic yard.

# CONCRETE REQUIREMENTS
## SECTION 4.3.0

## ANSWERS TO ASSIGNMENT #1

1. 6.34 cu. yds.
2. 7.04 cu. yds.
3. .24 cu. yds.
4. .20 cu. yds.
5. .11 cu. yds.
6. .07 cu. yds.
7. 12.32 cu. yds.
8. .48 cu. yds.
9. 26.80 cu. yds.
10. 1.34 cu. yds.
11. 28.14 cu. yds.
12. $1125.60

## STATEMENT OF OBJECTIVES

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

SECT. 4.4.0 Placing Concrete

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL PLACE CONCRETE IN THE HORIZONTAL POSITION AND COMPLETE THE NECESSARY TASKS TO PREPARE THE CONCRETE FOR THE FINISHING OPERATIONS.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

4.4.1 List eleven (11) essential items (tools and equipment) that must be ready and waiting at the job site where the concrete is delivered and ready for placement.

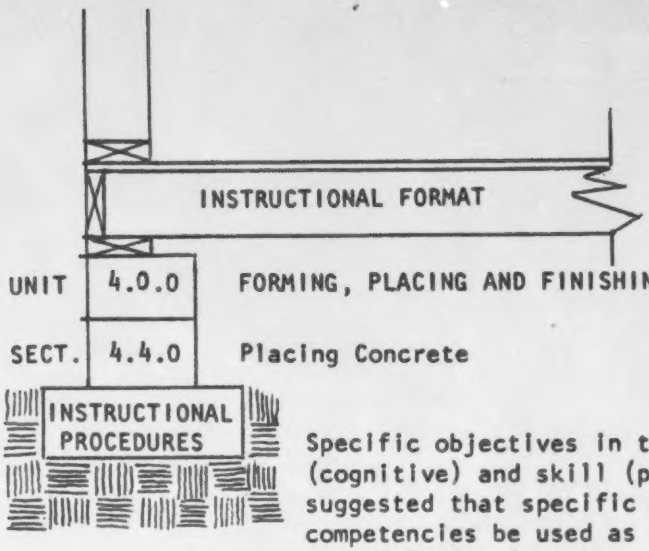
4.4.2 Develop a detailed sketch of plans for transporting concrete to a specific placement site from the redi-mix truck. Plan routing in reference to direct placement from chute, wheelbarrow, or bucket.

4.4.3 Place concrete uniformly to the full depth of the forms and as near as possible to the final position.

4.4.4 Spade concrete along forms for compaction and to eliminate the formation of voids and honeycomb.

4.4.5 Remove excessive concrete from within the form by bringing the surface to grade by strikeoff.

4.4.6 Level ridges and fill voids in concrete with a bull-float or darby immedicately after completing the strikeoff.



## INSTRUCTIONAL FORMAT

UNIT 4.0.0 FORMING, PLACING AND FINISHING CONCRETE

SECT. 4.4.0 Placing Concrete

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local construction firms with skilled concrete finishers in their employ.

# PLACING CONCRETE
## SECTION 4.4.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Preparation requirements

   A. Advance planning checklist

      1. Forms

      2. Subgrade

      3. Manpower

      4. Tools

      5. Materials

   B. Essential placing and finishing tools, equipment and materials

      1. Wheelbarrow

      2. Shovel

      3. Straightedge

      4. Bull float

      5. Edger

      6. Groover

      7. Float

      8. Trowel

      9. Broom

      10. Water hose

      11. Curing materials

II. Transporting concrete

   A. Manpower needed

B. Transporting concrete

1. Ready mix truck chute to subgrade

2. Wheelbarrow

3. Commerical applications

C. Transport problems

1. Condition of soil

2. Obstructions

a. Sidewalks

b. Driveway

c. Fence

d. Adjacent house

III. Spreading and compacting

A. Spreading techniques

1. Uniformity

2. Final position placement

3. Slanting position

4. Excessive drag or flow

B. Spreading and spading methods

1. Shovel, short-handle, square-end

2. Special tools

a. Concrete rakes

b. Come-alongs

3. Use of garden rakes and hoes

- C. Pre-strikeoff and bull floating essentials
    - 1. Perform strikeoff and bull-floating before collection of bleed water
    - 2. Strikeoff areas
    - 3. Bull-float areas
    - 4. Bleed water precautions

IV. Strikeoff

- A. Definition
- B. Tools
    - 1. Strikeoff
    - 2. Straightedge
    - 3. Construction materials
- C. Strikeoff techniques
    - 1. Motion
    - 2. Loading ahead of strikeoff
    - 3. Passing distance
    - 4. Passing times
    - 5. Tilt direction

V. Bull-floating and darbying

- A. Purposes
    - 1. Level ridges and voids
    - 2. Embed coarse aggregate
    - 3. Raise cement paste

- B. Bull float
    - 1. Construction material
    - 2. Sizes
    - 3. Operation techniques
    - 4. Recommended use
- C. Darby
    - 1. Sizes
    - 2. Operation techniques

VI. Overworking concrete

# PLACING CONCRETE
## SECTION 4.4.0

## ASSIGNMENT #1 - CONCRETE PLACEMENT TERMINOLOGY

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

________1. In concrete flatwork a smoothing tool used immediately after strike-off of small areas

________2. In concrete flatwork, a special tool used to round off the edges of slabs and steps

________3. The compacting of newly placed concrete against the forms to prevent the formation of voids on the surface

________4. Results from the use of ordinary garden rakes and hoes for purpose of moving or spreading concrete within the form area

________5. The process of removing the excess concrete to grade within the form

________6. A condition on the surface of freshly placed concrete that results in serious dusting or scaling if any operation is performed

________7. The apperance of a powdery material at the surface of newly hardened concrete

________8. Local flaking or peeling away of the outer surface of concrete or mortar

________9. An intermediate step usually done after edging and jointing and before troweling

________10. Another name for the strikeoff operation

a. Bleed water
b. Scaling
c. Edging
d. Darby
e. Floating
f. Strikeoff
g. Screeding
h. Segregation
i. Spading
j. Dusting

# PLACING CONCRETE
## SECTION 4.4.0

## ANSWERS TO ASSIGNMENT #1

1. d
2. c
3. i
4. h
5. f
6. a
7. j
8. b
9. e
10. g

## STATEMENT OF OBJECTIVES

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

SECT. 4.5.0 Finishing Concrete

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL PERFORM THE STEPS NECESSARY TO FINISH CONCRETE IN THE CORRECT MANNER AND SEQUENCE THAT WILL RESULT IN A HIGH QUALITY, DURABLE AND SERVICEABLE SURFACE.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

4.5.1 List five factors that control the length of the waiting period immediately preceeding the first finishing operation.

4.5.2 Cut concrete away from the forms before edging to a depth of one (1) inch immediately after floating.

4.5.3 Compact and harden the concrete surface next to the form into a rounded edge using an edging tool with a 1/2 inch radius when the concrete has firmed enough to hold the shape of the edge tool.

4.5.4 Compare three (3) kinds of control joints used in concrete walks, drives and patios. Include full scale sketches of each kind and complete detailed dimensions.

4.5.5 Layout and hand tool control joints in drive, walk, or patios as specified by Minimum Property Standards for One and Two Living Units.

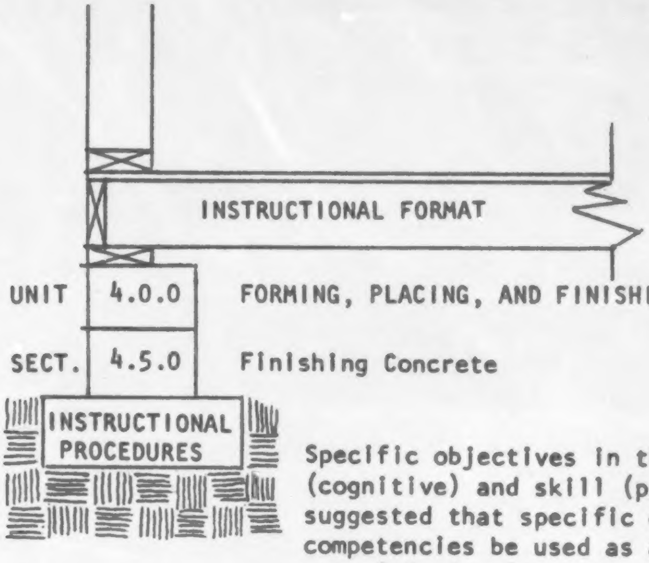
4.5.6 Explain in writing three (3) purposes for floating concrete.

4.5.7 Level the surface of concrete by floating using a hand operated float of a size adequate for the job.

4.5.8 Trowel the surface of concrete to a smooth, hard, dense surface.

> NOTE: A SECOND OR THIRD TROWELING MAY BE
> NECESSARY TO INCREASE SMOOTHNESS
> AND HARDNESS.

4.5.9 Broom the surface of concrete to create an attractive textured nonslip surface.



INSTRUCTIONAL FORMAT

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE - HORIZONTAL

SECT. 4.5.0 Finishing Concrete

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

  A. Provide learner with statement of objectives sheet

  B. Discuss terminal and specific objectives

  C. Provide learner with instruction sheets for use with this section

  D. Explain evaluation procedures

II. Suggested instructional methods:

  A. Demonstration - to show manipulative operations at construction site

  B. Discussion - to encourage question and answer activities

  C. Team assignment - to enhance personal relationships in the work environment.

  D. Illustrated lecture - to introduce a lesson or focus attention

  E. Field trips - to illustrate construction techniques and application of materials

  F. Consultant - representatives of local construction firms and labor organizations with skilled concrete finishers in their employ.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Types of Control Joints
    - 2. TM 2 - Isolation and Control Joints
- D. Assignment sheet #1 - Concrete Finishing Operations
- E. Answers to assignment sheet #1

IV. References:

- A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.
- B. Portland Cement Association. "Cement Mason's Guide to Building Concrete Walks, Drives, Patios and Steps". Skokie, Illinois: Portland Cement Association, 1971, 3rd. Printing 1974.
- C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# FINISHING CONCRETE
## SECTION 4.5.0

## INFORMATION SHEET - CONTENT OUTLINE

- I. Preliminary information
  - A. Bleed water evaporation factors
    - 1. Wind
    - 2. Temperature
    - 3. Relative humidity
    - 4. Type of concrete
    - 5. Temperature of concrete
    - 6. Air-entrained concrete
  - B. Conditions for beginning finishing operations
    - 1. Water sheen
    - 2. Foot pressure test
- II. Edging
  - A. Preliminary edging
    - 1. Tool construction
    - 2. Radius size
    - 3. Approximate tool size (10x6 in.)
    - 4. Separation of concrete and forms
    - 5. Conditions for preliminary edging
  - B. Intermediate edging
  - C. Final edging

        b. Types of power equipment
            1.) Gasoline driven power saw
            2.) Electric power saw
        c. Sawing techniques
            1.) Depth
            2.) Timing (4 to 12 hrs. after hardening)

D. Isolation joints
    1. Definition
    2. Purpose
    3. Material
    4. Size
    5. Potential stress points
        a. Rigid objects
        b. Intersections
    6. Abuses
        a. Omitted
        b. Over-use (regular intervals in sidewalks and driveways)
    7. Installation requirements
        a. Height placement
        b. Anchoring methods

E. Construction joint
    1. Definition
    2. Purpose
    3. Use as control joint
    4. Load transfer technique

III. Jointing

- A. Purposes
- B. Control joints
  - 1. Purposes
  - 2. Types
    - a. Hand tooled
    - b. Sawed
    - c. Wood divider strips
    - d. Isolation joints (expansion)
    - e. Construction joints
  - 3. Spacing
    - a. Driveways and walks (slab width intervals)
    - b. Extra wide drives and walks (longitudinal)
    - c. Patios (10ft. limitation)
    - d. Length to width ratio (1 1/2 to 1)
    - e. Continuous (not offset)
- C. Jointing tools and equipment
  - 1. Hand tools
    - a. Names
    - b. Tool construction
    - c. Radius size (1/4 to 1/2 in.)
    - d. Cutting depth (1/5 to 1/4 slab thickness)
    - e. Groover guide
  - 2. Power equipment
    - a. Cutting methods

IV. Floating

  A. Sequence

  B. Purposes

    1. Embed large aggregate just below surface

    2. Remove surface imperfections from previous operations

    3. Compact concrete and consolidate mortar at the surface for further finishing

  C. Hand floats

    1. Fabrication materials

    2. Purposes

    3. Use

    4. Power floats

V. Troweling

  A. Hand troweling

    1. Timing sequence

    2. Purpose

    3. Large slab techniques

  B. Hand trowels

    1. Fabrication materials

    2. Customary sizes

      a. First troweling - 18 x 4 3/4 in.

      b. Final troweling - 12 x 3 in.

      c. Single size trowel operation - 14 x 4 in.

  C. Troweling techniques

    1. First troweling

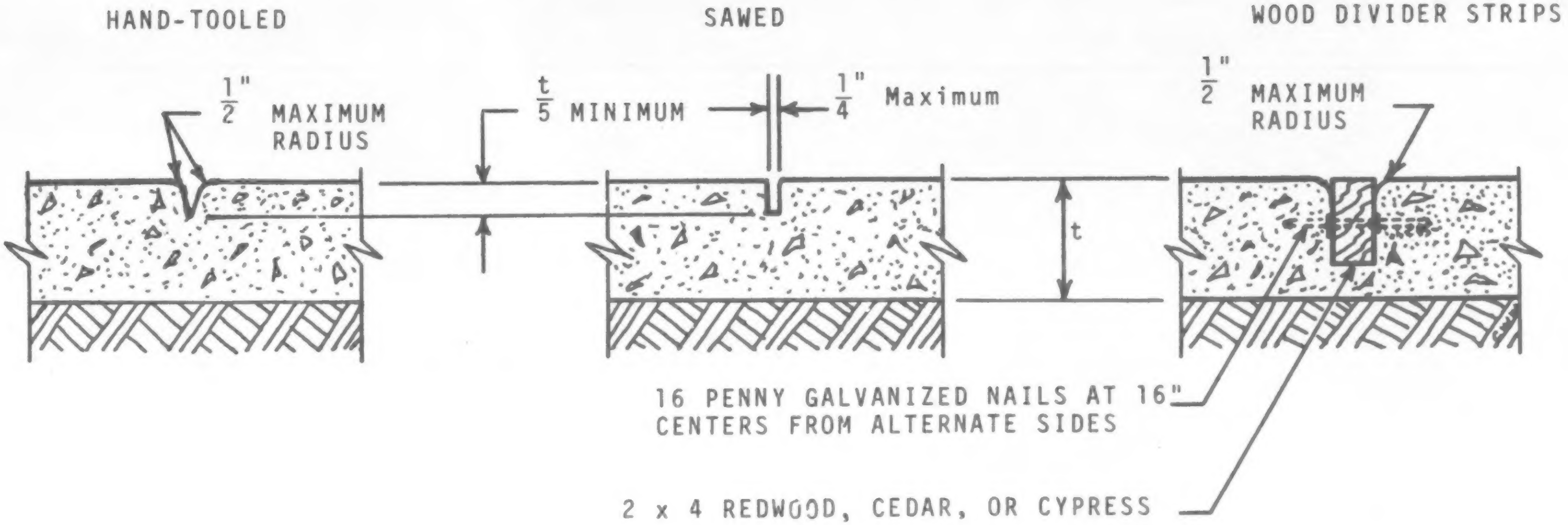
      a. Flat sweeping arc motions

      b. Overlapping passes

2. Second troweling
    a. Timing sequence
    b. Test to begin
3. Third troweling

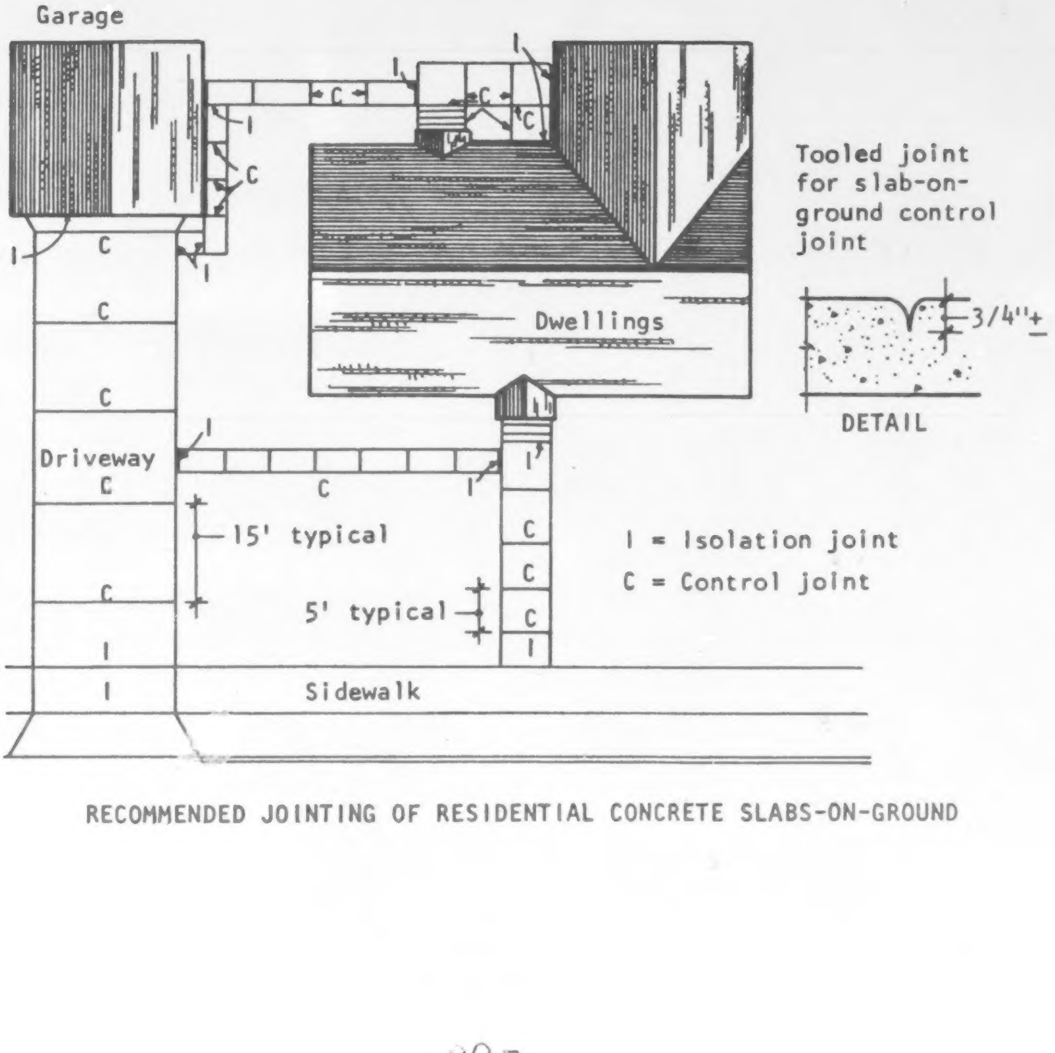
D. Non-slip surface
    1. Textured
    2. Abrasive grains
    3. Geometric patterns
    4. Exposed aggregate

# TYPES OF CONTROL JOINTS



4.5.0 - TM 1

# ISOLATION AND CONTROL JOINTS



RECOMMENDED JOINTING OF RESIDENTIAL CONCRETE SLABS-ON-GROUND

# FINISHING CONCRETE
## SECTION 4.5.0

## ASSIGNMENT #1 - CONCRETE FINISHING OPERATIONS

After studying the information in the references, complete the answers to the following activities.

1. List five factors that control the length of the waiting period that occurs immediately before the bleed water leaves the surface of freshly placed concrete.

   a. b.

   c. d.

   e.

2. Cut concrete away from the forms to a depth of (a)____________________ inch immediately after (b)____________________________________________.

3. (a)____________________compacts and hardens the concrete surface next to the form where floats and trowels are less effective.

4. List three kinds of control joints generally used in the construction of concrete walks, drives, and patios.

   a.

   b.

   c.

5. Another name for control joints is (a)____________________joints.

6. Breifly list three purposes for floating concrete.

   a.

   b.

   c.

7. Correct __________________ practices can eliminate unsightly random cracks.

8. A type of control joint required at points of potential stress, such as around rigid objects or at intersections of walks and drives.

   a.

9. A type of joint required where concreting operations are temporarily suspended or where concreting is stopped at the end of the work day.

   a.

10. The operation of producing a smooth, hard, dense surface to concrete is called (a)________________________________________.

## FINISHING CONCRETE
## SECTION 4.5.0

### ANSWERS TO ASSIGNMENT #1

1. a. Wind
   b. Temperature
   c. Relative humidity
   d. Type of concrete
   e. Temperature of concrete
2. a. One
   b. Floating
3. a. Edging
4. a. Hand-tooled
   b. Sawed
   c. Wood divider strips
5. a. Contraction
6. a. Embed large aggregate just below surface
   b. Remove surface imperfections from previous operation
   c. Compact concrete at surface for further finishing
7. a. Jointing
8. a. Isolation or expansion
9. a. Construction
10. a. Troweling

## STATEMENT OF OBJECTIVES

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE

SECT. 4.6.0 Curing Concrete

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION THE LEARNER WILL BE ABLE TO SELECT APPROPRIATE CONCRETE CURING METHODS THAT ARE COMPATABLE WITH VARIABLE FIELD CONDITIONS UNDER WHICH CONTROLLED CURING MUST OCCUR. DETAILS, SUCH AS LENGTH OF CURING PERIODS, COLD AND HOT WEATHER CURING PROCESSES, AND THE USE OF CONCRETE ADDITIVES, WILL BE EXPERIENCED.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

4.6.1 State, in writing, two conditions under which the curing process of hydration stops during the curing process.

4.6.2 Write three (3) acceptable methods of curing concrete.

4.6.3 Cover and seal fresh troweled concrete with 4 mil polyvinyl cover (sheeting).

4.6.4 Compare, in writing, the length of curing periods of concrete for 70 degree F. or higher temperatures with temperatures from 50 to 70 degrees F.

4.6.5 List three ways the curing period of concrete may be reduced from seven (7) to three (3) days during cold weather periods.

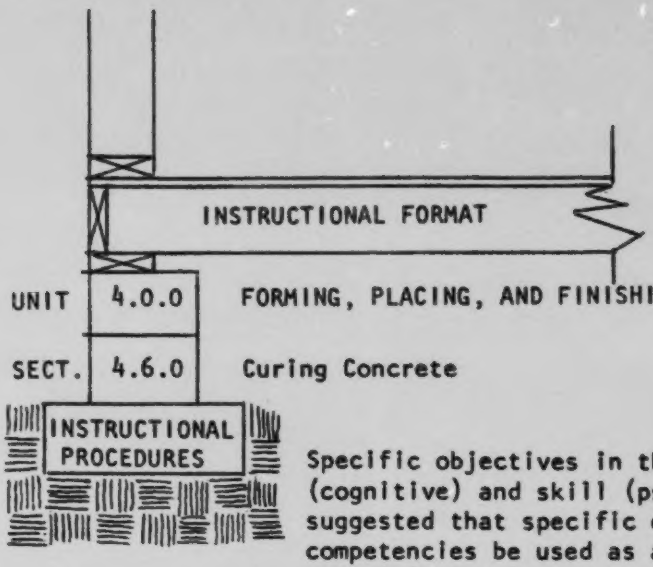
4.6.6 List five (5) ways to help prevent rapid loss of surface moisture from concrete during extremely hot and dry weather periods.

4.6.7 Identify one (1) likely damage to cured concrete surfaces resulting from the use of de-icers.

4.6.8 Define the term "air entrainment" in relation to a plastic concrete mix.

4.6.9 List three (3) advantages of air entrained concrete in the plastic state.

4.6.10 List three (3) advantages of air entrained concrete in the cured state.



## INSTRUCTIONAL FORMAT

UNIT 4.0.0 FORMING, PLACING, AND FINISHING CONCRETE

SECT. 4.6.0 Curing Concrete

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local construction or highway construction firms who have skilled concrete finishers in their employ.

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Assignment sheet #1 - Purpose and Methods of Curing Concrete

D. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Portland Cement Association. "Cement Mason's Guide to Building Concrete Walks, Drives, Patios and Steps". Skokie, Illinois: Portland Cement Association, 1971, 3rd., Printing, 1974.

C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

## CURING CONCRETE
## SECTION 4.6.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Purpose of curing
    A. Hardening process
        1. Hydration
        2. Conditions
            a. Water content
            b. Temperature control
    B. Hydration stoppage
        1. Moisture evaporation
        2. Freezing temperature

II. Methods of curing
    A. Moist-curing
        1. Wet coverings
        2. Sprinkling
        3. Ponding
    B. Sealing the surface
        1. Moisture barriers
        2. Disadvantages
        3. Advantages
    C. Pigmented spray compounds
    D. Curing period
        1. Warm weather (5 days at 70 degree F.)
        2. Cooler weather (7 days at 50-70 degrees F.)

III. Cold weather curing

- A. Temperature control methods
    1. Heated concrete
    2. Maintain 50 degree F. or above
    3. Insulating blankets
    4. Straw
- B. Accelerated setting time and strength development
    1. Maintain 50 degree F. temperature
    2. High-early-strength concrete
        - a. Type III cement
        - b. Extra 100 lb. of cement p.c.y.
        - c. Up to 2 percent calcium chloride (weight)

IV. Hot weather curing

- A. Rapid moisture loss precautions
    1. Dampening subgrade and forms
    2. Sufficient manpower
    3. Sunshade and windbreaks
    4. Temporary coverings
    5. Light fog sprays
    6. Begin curing immediately

V. Use of surface de-icers

- A. Purpose

B. De-icing chemicals
   1. Calcium chloride
   2. Others
   3. Negative effects
   4. Positive effects

VI. Air entrained concrete
   A. Definition
   B. Plastic state advantages
      1. Improved workability
      2. Improved placeability
      3. Reduced bleeding
      4. Possible lower costs
   C. Cured state advantages
      1. Resistance to weathering
      2. Resistance to scaling
      3. Improved durability
      4. Assists frost-resistance

# CURING CONCRETE
## SECTION 4.6.0

### ASSIGNMENT #1 - PURPOSE AND METHODS OF CURING CONCRETE

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

______1. Condition describing fresh concrete that can be moved and molded into any shape.

______2. The hardening of concrete achieved by chemical reactions between cement and water

______3. Procedure for keeping freshly placed concrete warm and moist

______4. A condition under which the concrete hardening process stops

______5. A sealing curing method

______6. A water curing method

______7. A limiting factor to curing process

______8. A concrete ingredient used to accelerate the setting time and strength development under cold weather conditions

______9. A process used to improve the workability and frost resistance of concrete

______10. A curing method in which pigmented compounds are applied to the damp, but not wet, finished concrete surface

a. Excessive water loss

b. Plastic sheeting cover

c. Ponding

d. High-early-strength cement

e. Plastic state

f. Air-entrainment

g. Temperature

h. Curing

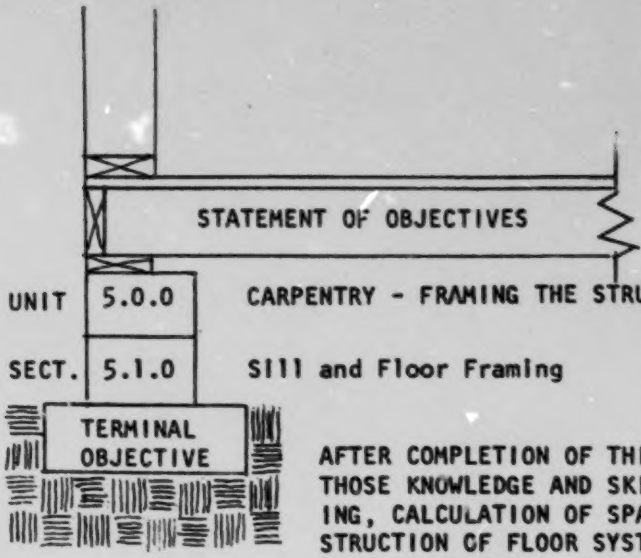
i. Hydration

j. Spray

# CURING CONCRETE
## SECTION 4.6.0

### ANSWERS TO ASSIGNMENT #1

1. e
2. i
3. h
4. a
5. b
6. c
7. g
8. d
9. f
10. j



## STATEMENT OF OBJECTIVES

UNIT 5.0.0 CARPENTRY - FRAMING THE STRUCTURE

SECT. 5.1.0 Sill and Floor Framing

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL PERFORM THOSE KNOWLEDGE AND SKILL TASKS RELATED TO TYPE OF FRAMING, CALCULATION OF SPACE, LAYOUT AND MEASUREMENT, CONSTRUCTION OF FLOOR SYSTEMS INCLUDING SUB-FLOOR MATERIALS AND APPLICATIONS, TERMIT AND WEATHER PROTECTION.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

5.1.1 Differentiate between platform (western) and balloon framing by sketching three (3) basic differences in their framing techniques.

5.1.2 Calculate the maximum allowable span for floor joints of a particular species, grade, use and spacing from span tables published by the National Forest Products Association.

5.1.3 Sketch and identify all floor and sill framing members.

5.1.4 Install/apply termit protection according to local building codes or HUD Minimum Property Standards.

5.1.5 Layout, cut, and fabricate (in place) a built-up wood girder.

> NOTE: LAYOUT LINES ON LUMBER WILL BE ACCURATE WITHIN THE WIDTH OF A PENCIL (SHARP) LINE. TOLERANCES-ALL MEASUREMENTS ASSOCIATED WITH FRAMING ARE + 1/16 INCHES UNLESS OTHERWISE NOTED. A RELIABLE GENERAL GUIDE IS TO LEAVE THE PENCILED LINE WHEN CUTTING.

5.1.6 Layout, cut and pre-fit foundation sills to the top of foundation walls.

5.1.7 Layout and bore holes in foundation sills to facilitate fastening sills to foundation walls with anchor bolts (previously placed).

5.1.8 Layout and install sill sealer to foundation wall top.

5.1.9 Install sill over foundation anchor bolts and sill sealer.

5.1.10 Layout and mark position of each floor joist on the joist headers and girder.

5.1.11 Place header joists in position and toenail them to the foundation sill.

5.1.12 Place floor joists in position (with the crown up) and nail to joist header and together over girder if applicable.

5.1.13 Frame all openings in the floor system by maintaining accurate layout, cutting and installation of trimmer, header and tail joists.

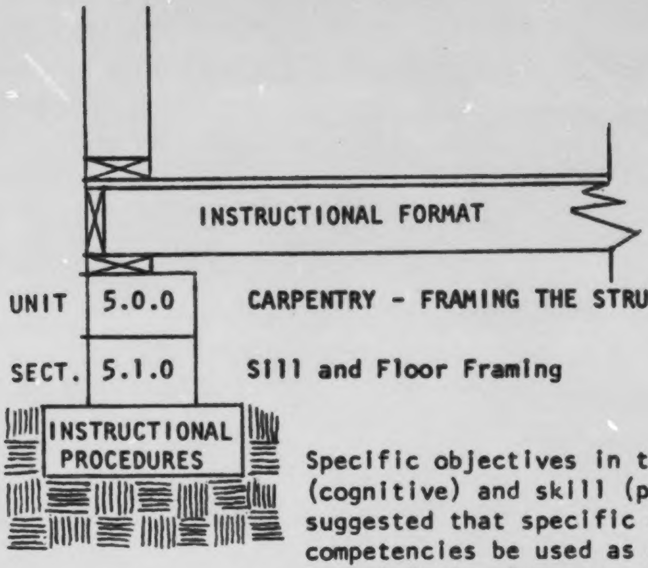
5.1.14 Describe three (3) kinds of bridging and write the purpose for which the use of bridging is intended.

5.1.15 Layout, cut and install wood cross bridging in a floor system. (Nail tops only)

5.1.16 Write two main purposes and list four kinds of materials that may be used for the subfloor of a residential structure.

5.1.17 Layout, cut and install shiplap or common boards at a 45 degree angle with the floor joists.

5.1.18 Install plywood over floor joists spaced 16 inches on center with the long dimension of the sheets perpendicular to the joists and with joints "broken" in successive courses. Installation and specifications are to meet HUD Minimum Property Standards.



## INSTRUCTIONAL FORMAT

UNIT 5.0.0 **CARPENTRY - FRAMING THE STRUCTURE**

SECT. 5.1.0 **Sill and Floor Framing**

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local or area carpentry apprenticeship schools, representatives of local or area carpentry labor organization who may provide supplementary information about sill and floor framing.

III. Instruction materials included in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

1. TM 1 - Platform Frame Construction
2. TM 2 - Balloon Frame Construction
3. TM 3 - Foundation Sill Installation and Layout
4. TM 4 - Floor System Members
5. TM 5 - Floor Framing For Small Openings
6. TM 6 - Bridging
7. TM 7 - Subfloors
8. TM 8 - Types of Nails
9. TM 9 - Size of Nails

C. Assignment sheet #1 - Material Estimating (Floor and Sill)

D. Answers to assignment sheet #1

IV. References:

A. Cooper, George H. and Stanley Badzinski, Jr. Building Construction Estimating. St. Louis, Missouri: McGraw Hill, 1971.

B. Durbahn, Walter E. and Robert E. Putnam. Fundamentals of Carpentry Tools, Materials and Practices. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

C. Durbahn, Walter E. and Elmer E. Sundberg. Fundamentals of Carpentry Practical Construction. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

D. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

E. Putnam, Robert E. and G. E. Carlson. *Architectural and Building Trades Dictionary*. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

F. Smith, Ronald C. *Principles and Practices of Light Construction*. Englewood Cliffs, New Jersey: Printice Hall Inc., 1970

G. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# SILL AND FLOOR FRAMING
## SECTION 5.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Types of framing

   A. Platform characteristics

      1. Provides work surface

      2. Firestop advantage

      3. High safety factor

      4. Uniform shrinkage

   B. Balloon characteristics

      1. Continuous studs

      2. Floor joist support

      3. Firestop provisions

      4. Service access

      5. Shrinkage

II. Sill and floor framing members

   A. Beam or girder

   B. Sill

   C. Joist header

   D. Joist

   E. Bridging

      1. Wood

      2. Metal

      3. Solid

   F. Subfloor

III. Termite Protection - see section 3.1.0

- A. Termite shields
- B. Lumber treatment
- C. Soil poisoning

IV. Girder and beam construction

- A. Purpose
- B. Types of construction
  - 1. Solid wood
  - 2. Built-up members
  - 3. Steel beams
- C. Procedure for ascertaining girder size
  - 1. Span
  - 2. Girder load width
  - 3. Total floor load per. sq. ft.
  - 4. Total girder load - girder span x girder load width x total floor load
  - 5. Girder size - table
- D. Fabrication specifications
  - 1. Lamination techniques
    - a. Lumber size
    - b. Nail size
    - c. Nail spacing
    - d. Joint location
    - e. Bearing minimums
    - f. Side and end clearance
    - g. Lumber species

- V. Sill installation
  - A. Anchor bolt hole layout
  - B. Installation procedures
    - 1. Hole size
    - 2. Prefit
    - 3. Sill sealer
    - 4. Alignment
- VI. Floor joists
  - A. Definition
  - B. Purpose
  - C. Specifications
    - 1. Size
    - 2. Spacing
    - 3. Deflection maximums
    - 4. Span table values
  - D. Layout
    - 1. Location
      - a. Sill
      - b. Joist header
      - c. Girder
    - 2. Marking systems
    - 3. Double joist conditions
      - a. Parallel partitions
      - b. Opening

4. Framing member terminology
    a. Header
    b. Trimmer
    c. Tail joist
    d. Double trimmer
    e. Regular joist

E. Installation techniques
    1. Header joist
    2. Regular joists
    3. Crown position
    4. Nailing specifications
        a. Header joist to sill - 12d
        b. Regular joist to header joist - 16d
        c. Joist overlap center - 10d
        d. Joist to girder - 10d
        e. Double joists together - 12 or 16d

VII. Framed openings
    A. Procedures
        1. Install trimmers
        2. Install first header and tail joists
        3. Install second header
        4. Install second trimmer joist
    B. Metal framing anchors

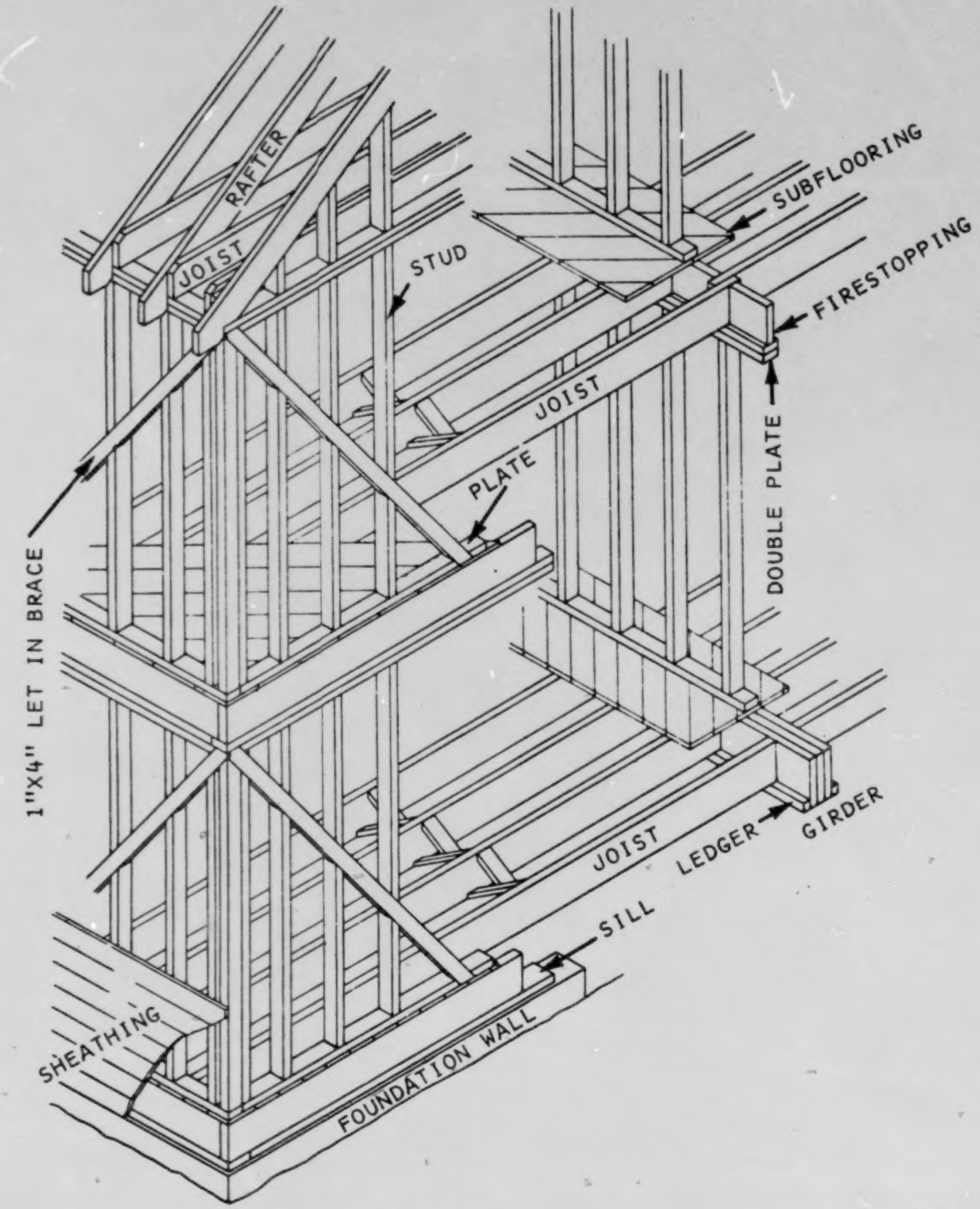
VIII. Bridging

A. Kinds
    1. Regular (cross bridging)
    2. Solid
    3. Steel
B. Purpose
C. Spacing

IX. Subfloors
    A. Materials
        1. Plywood
        2. Shiplap
        3. Tongue-and-grove flooring
        4. Common boards
        5. Fiberboard
    B. Installation specifications
        1. Shiplap or common boards
            a. Installation angle
            b. Purposes of angle installation
                1. Finish floor direction options
                2. Bracing factor
            c. Nailing
                1. Size
                2. Number
        2. Plywood
            a. Joint and joist relationship
            b. Long dimension relationships
            c. Sizes

- d. Nailing
    - 1. Size
    - 2. Spacing (5/8 - 8d - 6 - 10)
- 3. Use of adhesives
    - a. Type
    - b. Advantages

# PLATFORM FRAME CONSTUCTION



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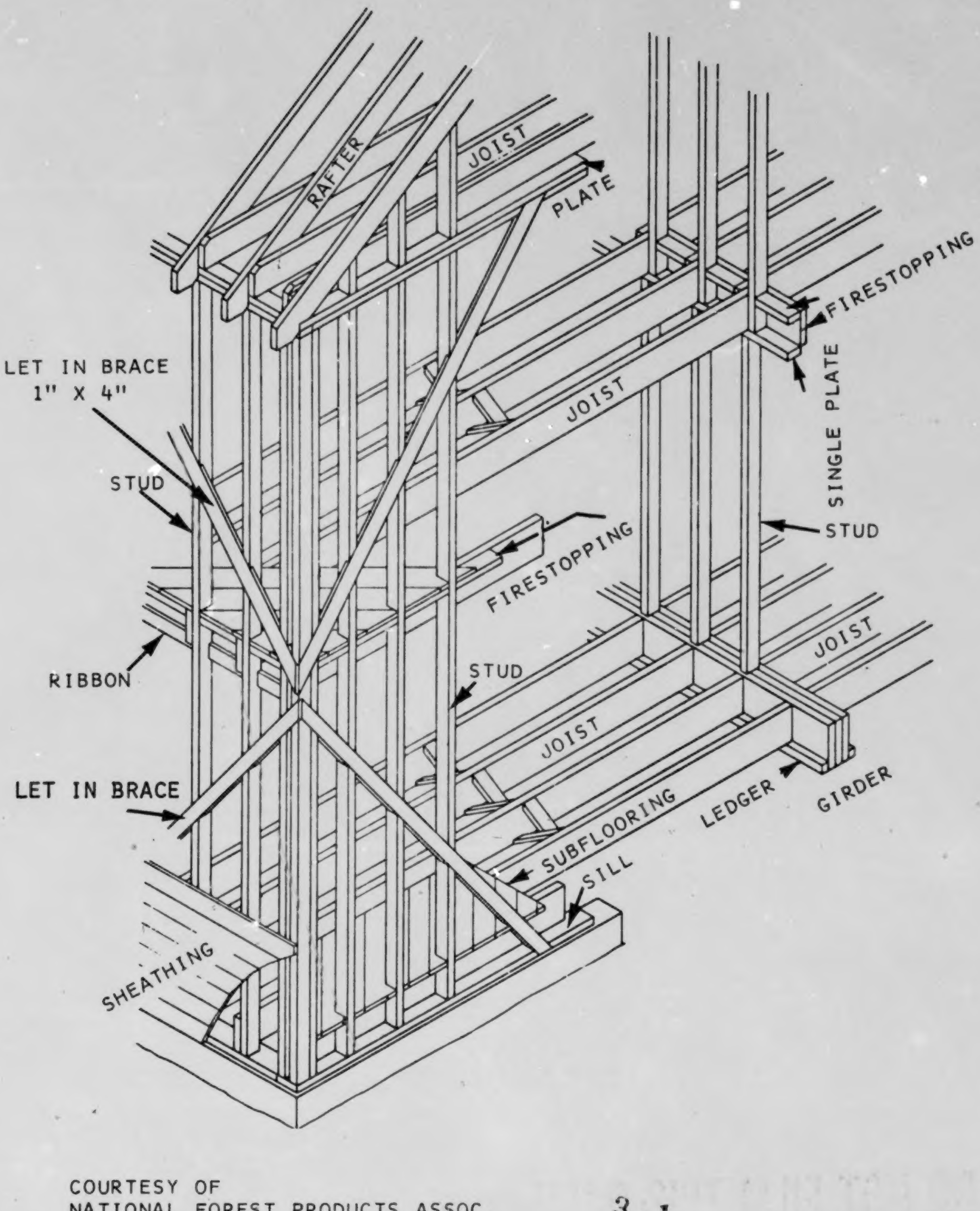
NATIONAL FOREST PRODUCTS ASSOC.
WASHINGTON, D.C.
IMI, UMC

# BALLOON FRAME CONSTRUCTION



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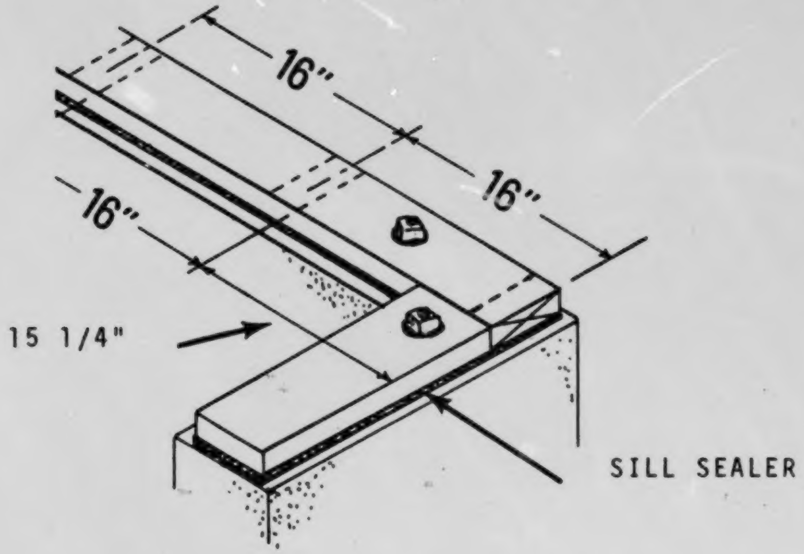
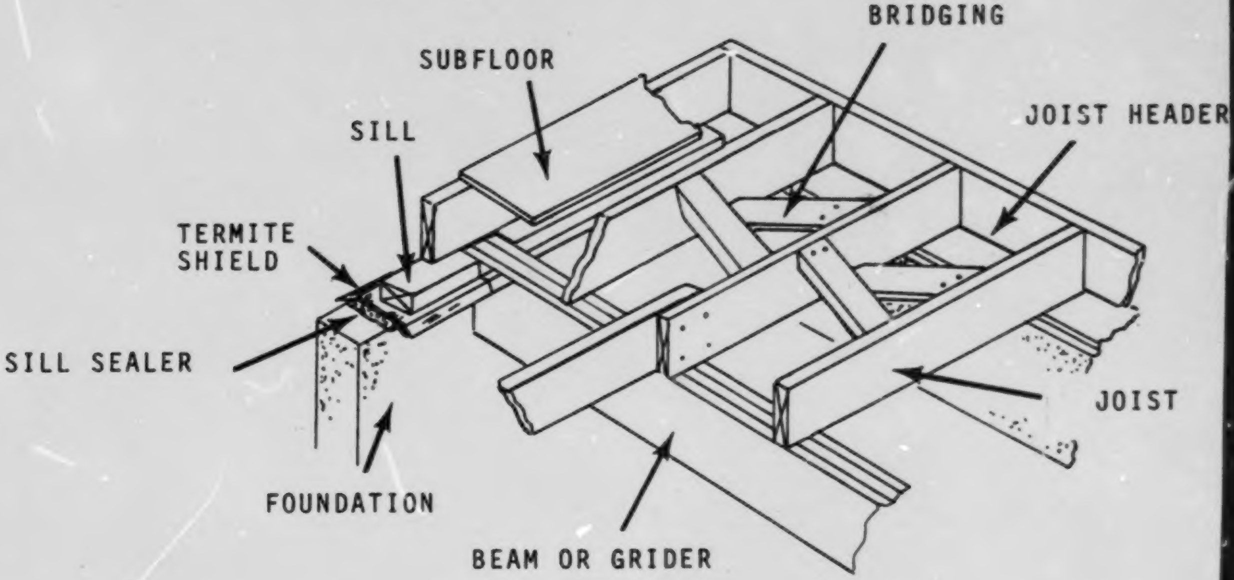
# FOUNDATION SILL INSTALLATIONS AND LAYOUT

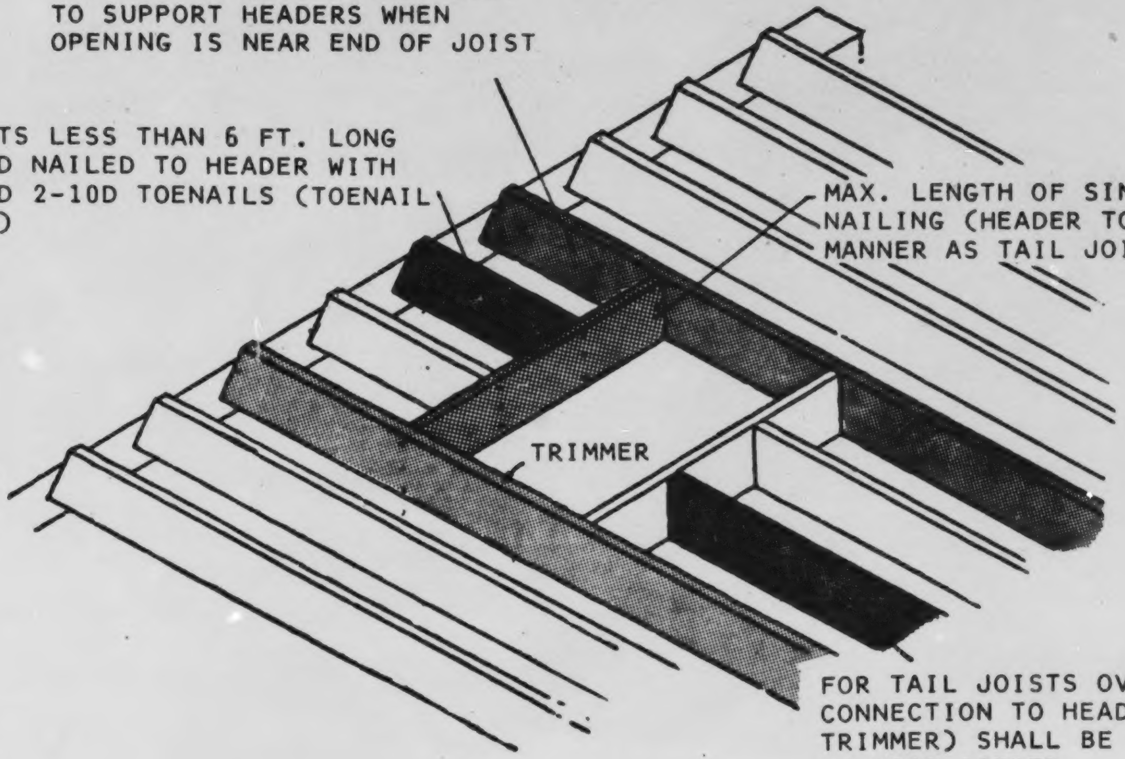
## SILL ANCHORS



# FLOOR SYSTEM MEMBERS



# FLOOR FRAMING FOR SMALL OPENINGS



SINGLE TRIMMERS MAY BE USED
TO SUPPORT HEADERS WHEN
OPENING IS NEAR END OF JOIST

TAIL JOISTS LESS THAN 6 FT. LONG MAY BE END NAILED TO HEADER WITH 3-16D ABD 2-10D TOENAILS (TOENAIL NOT SHOWN)

MAX. LENGTH OF SINGLE HEADER 4 FT. NAILING (HEADER TO TRIMMER) IN SAME MANNER AS TAIL JOIST TO HEADER

FOR TAIL JOISTS OVER 6 FT. IN LENGTH CONNECTION TO HEADER (AND HEADER TO TRIMMER) SHALL BE SAME AS FOR JOISTS TO WOOD GIRDER.

5.1.0 - TM 5

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MINIMUM PROPERTY STANDARDS

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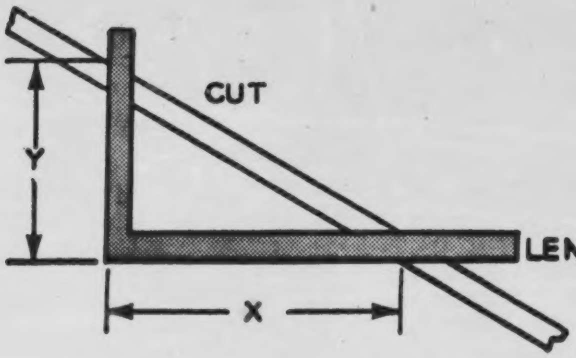
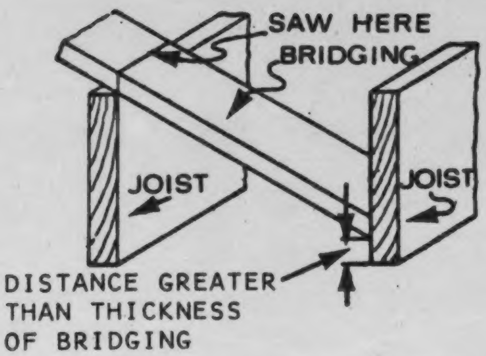
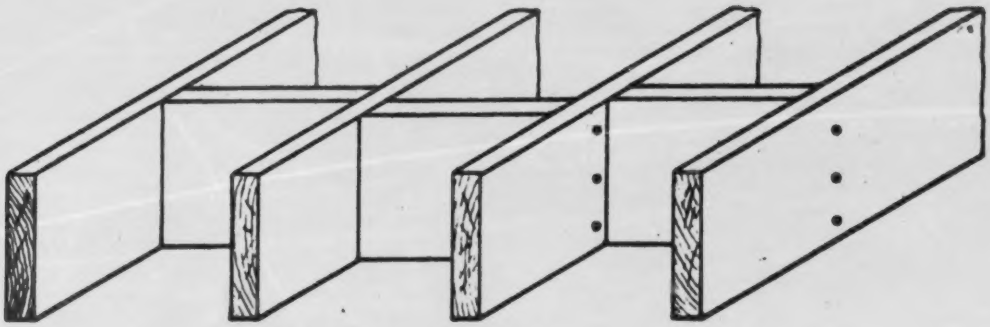
# BRIDGING



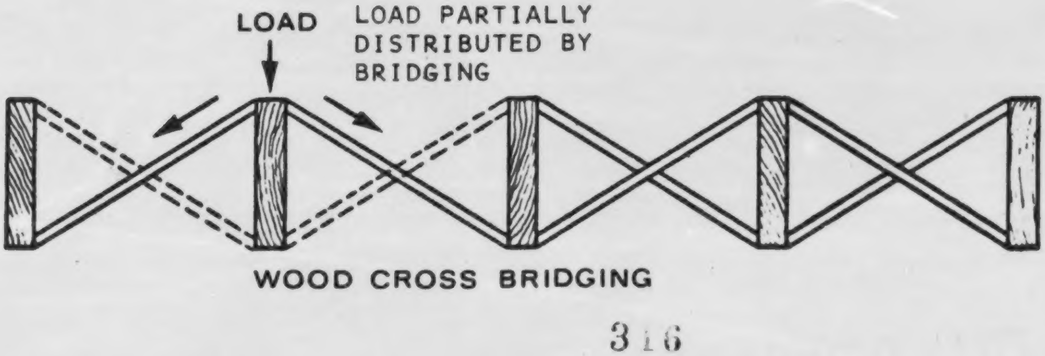
X IS THE DISTANCE BETWEEN JOISTS
Y IS THE WIDTH OF JOISTS



CUTTING BRIDGING



SOLID BRIDGING



WOOD CROSS BRIDGING

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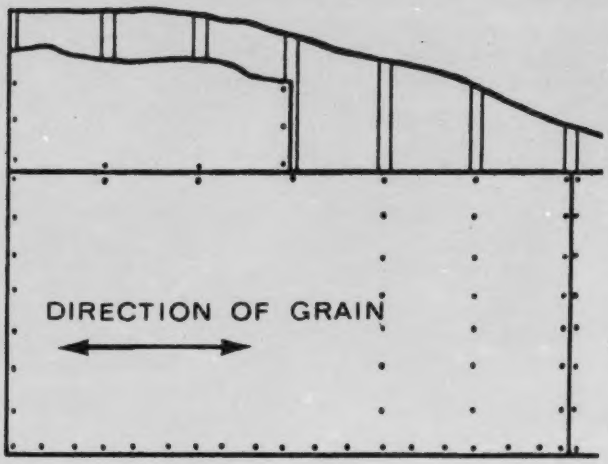
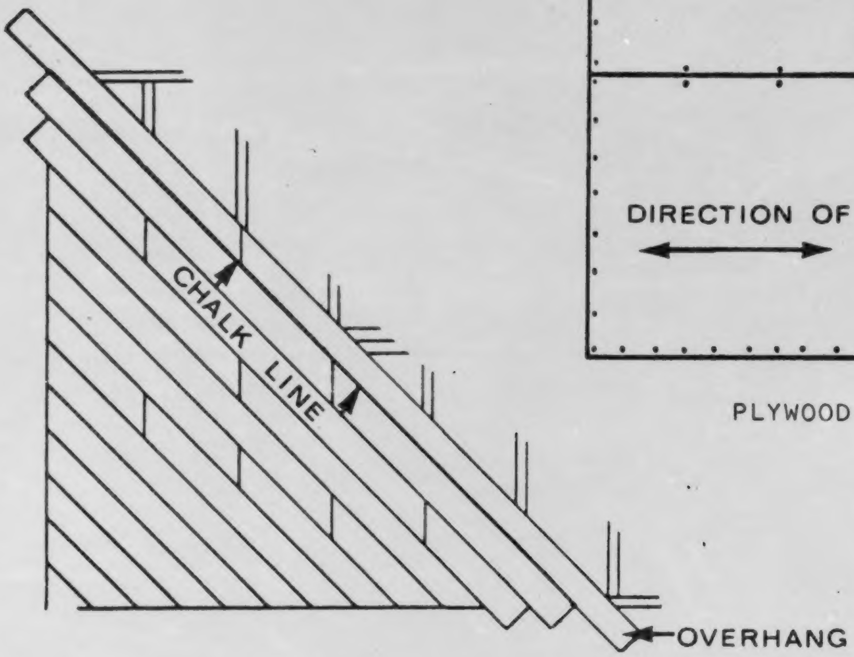
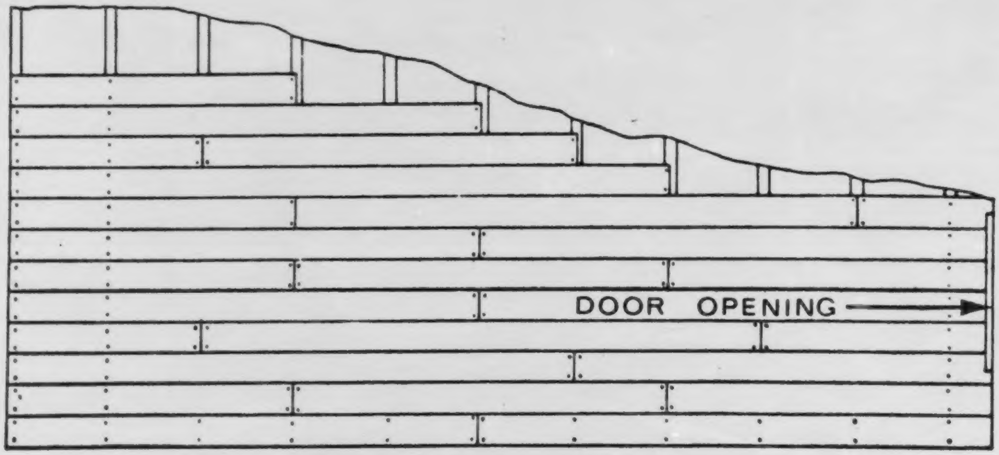
# SUBFLOORS



PLYWOOD SUBFLOORS



SUBFLOOR LAID DIAGONALLY TO JOISTS



SUBFLOOR LAID AT RIGHT ANGLES TO JOISTS

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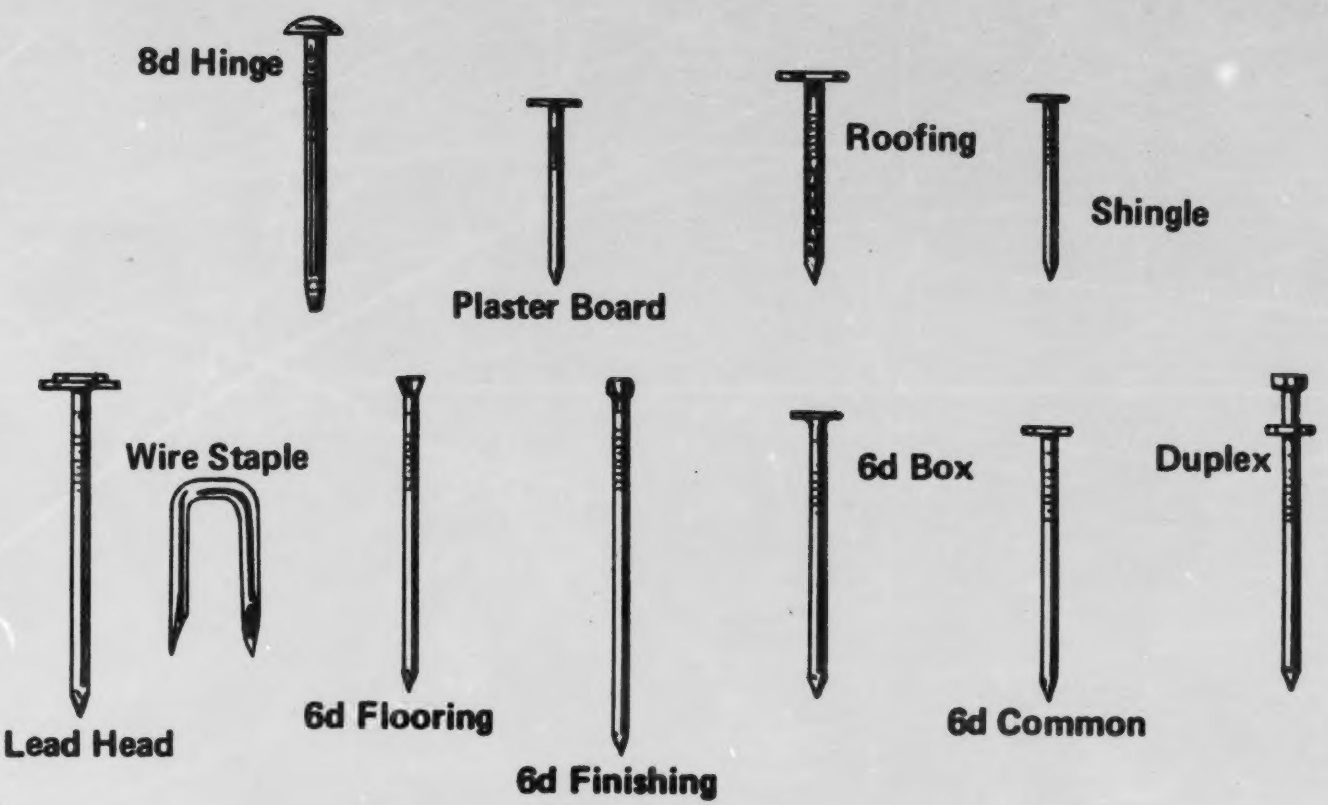
# Types of Nails



5.1.0 - TM 8

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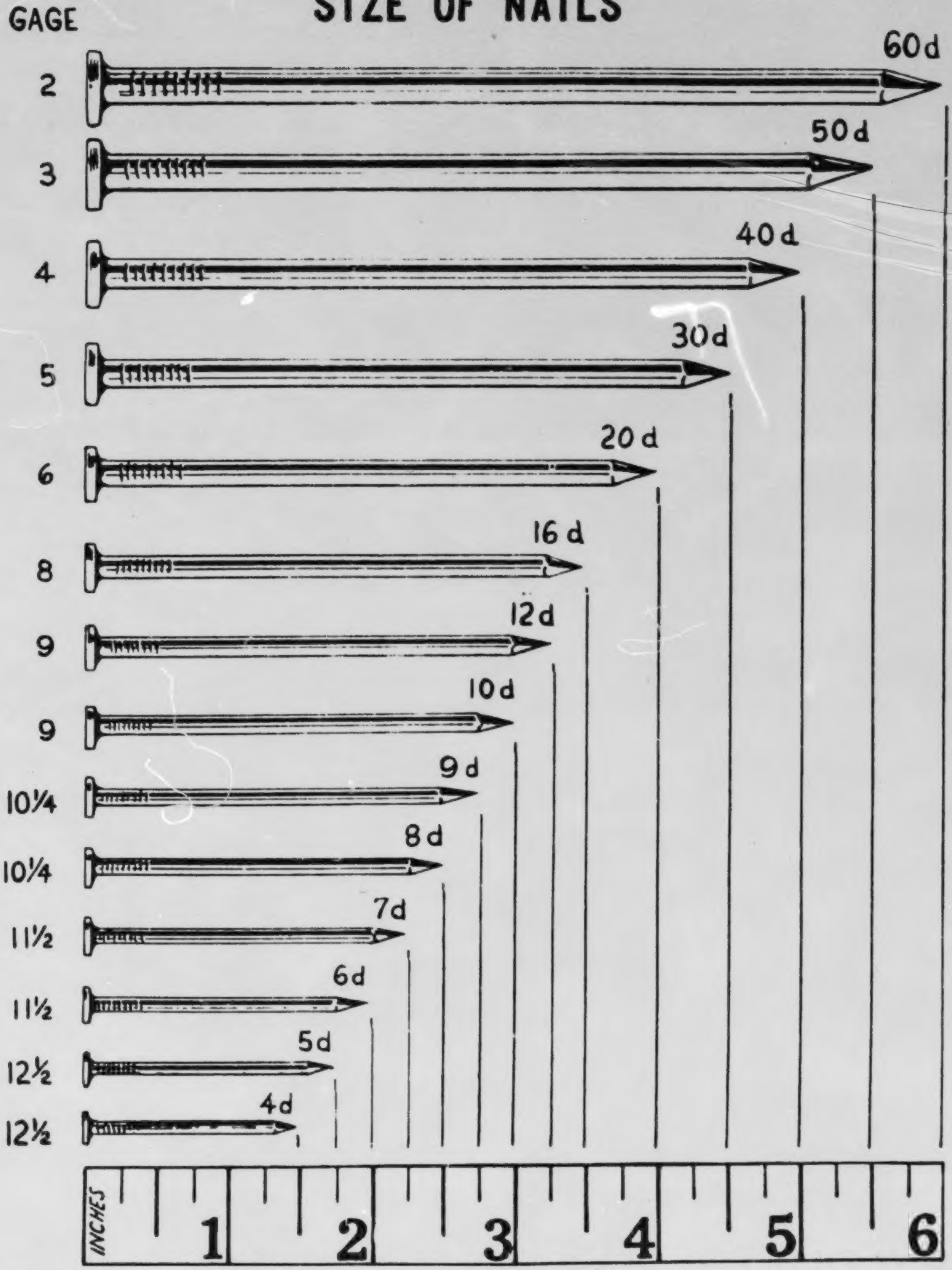
CURRICULUM AND INSTRUCTIONAL MATERIALS CENTER
STATE DEPARTMENT OF VOCATIONAL-TECHNICAL EDUCATION
STILLWATER, OKLAHOMA

IML-UMC

# SIZE OF NAILS



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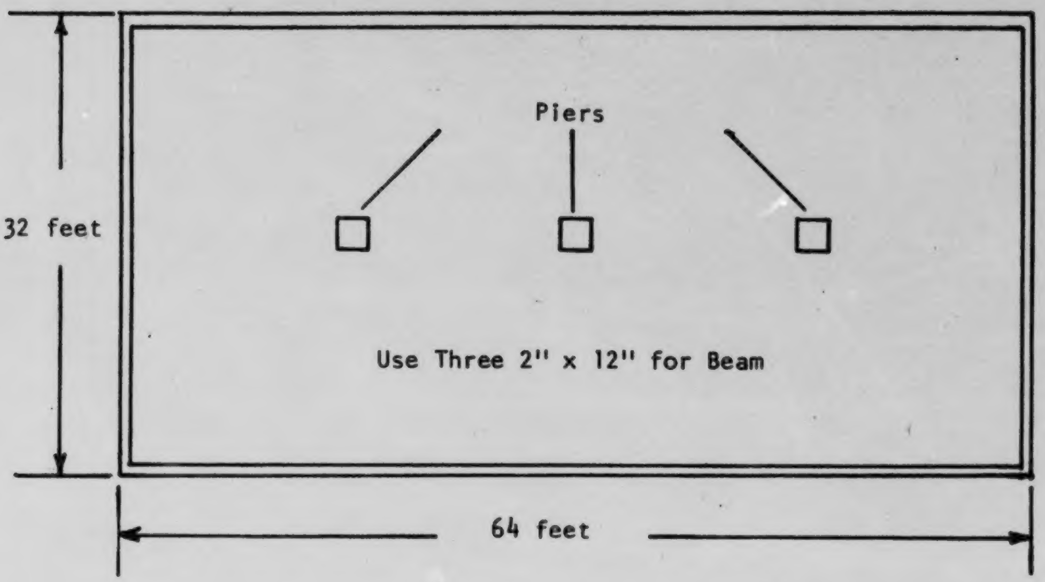
NATIONAL LUMBER MANUFACTURERS ASSOC.
MANUAL FOR HOUSE FRAMING
IML-UMC

## FLOOR AND SILL FRAMING
## SECTION 5.1.0

### ASSIGNMENT SHEET #1 - MATERIAL ESTIMATING

Calculate the floor and sill material needed for the house depicted below.

1. Sill sealer (Linear feet)____________________
2. Termite shield (Linear feet)__________________
3. Sill (Board feet 2" x 6")____________________
4. Beams or girders (Board feet 2" x 12")______________
5. Joists (Board feet 2" x 8" x 16" on centers)____________
6. Joist headers (Board feet 2" x 8")____________________
7. Bridging
    a. Board feet 1" x 4" __________________
    b. Metal (No. of pieces)________________
    c. Solid lumber (Linear feet)___________
8. Subflooring
    a. Board feet 1" x 6" square edge laid diagonally__________________
    b. Number of pieces 5/8" x 4' x 8' plywood laid at right angles_________
9. Nails
    a. 16d__________(10 lbs. per 1,000 board feet)
    b. 8d___________(kind of nails)
        1. Lumber subfloor__________(32 lbs. per 1,000 board ft.)
        2. Plywood subfloor_________(10 lbs. per 1,000 board ft.)
        3. Bridging________________(2 lbs. per 100 linear ft.)


Piers
32 feet
Use Three 2" x 12" for Beam
64 feet

## FLOOR AND SILL FRAMING
## SECTION 5.1.0

### ANSWERS TO ASSIGNMENT #1

1. 192 linear feet
2. 192 linear feet
3. 192 board feet of 2" x 6" x 16'
4. 384 board feet of 2" x 12" x 16'
5. 2,091 board feet of 2" x 8" x 16'
6. 171 board feet of 2" x 8" x 16'
7. a. 86 board feet of 1" x 4"
   b. 192 metal bridging
   c. 128 linear feet
8. a. 2,397 board feet of 1" x 6"
   b. 2,048 square feet or 64 pieces of 4' x 8' plywood
9. a. 25 pounds 16d box nails
   b. 8d box nails
      1. 77 pounds for solid lumber
      2. 21 pounds for plywood
      3. 2 pounds for bridging

## STATEMENT OF OBJECTIVES

UNIT 5.0.0 **CARPENTRY - FRAMING THE STRUCTURE**

SECT. 5.2.0 **Wall and Partition Framing**

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL DEFINE WALL AND PARTITION FRAMING TERMS, LAYOUT, CUT, FABRICATE AND ERECT WALL SECTIONS, IDENTIFY AND APPLY COMMONLY USED TYPES OF SHEATHING, LAYOUT, CUT AND INSTALL CEILING JOISTS.

## SPECIFIC OBJECTIVES

After completion of this section, the learner will:

5.2.1 Sketch and identify the framing members used in the assembly of vertical and horizontal members that form the exterior and interior walls of a residential structure. Include all members in one wall.

5.2.2 In a plan view sketch and identify three (3) common types of corner construction.

5.2.3 In a plan view, sketch and identify two (2) methods of anchoring partition walls to outside walls (intersections).

5.2.4 Layout location of outside walls and mark on subfloor using chalk line.

5.2.5 Layout location of partition walls and mark on subfloor using chalk line.

5.2.6 Cut exterior sole and top plate to length, place in position on subfloor and lay off location of all framing members to be placed within the wall. Use standard identification symbols.

5.2.7 Place sole and top plate in nailing and erection position.

5.2.8 Layout and cut wall studs (if not pre-cut), trimmers, cripples, and headers to length.

5.2.9 Fabricate corners, partition junctions ("T's") and headers according to local building code/HUD Minimum Property Standards, One and Two Family Dwelling, 1973.

5.2.10 Assemble exterior wall parts in a manner that will provide safe support of design loads as specified in HUD Minimum Property Standards, Manual of Acceptable Practices, 1973.

5.2.11 Erect exterior frame walls, plumb vertically (in two directions) and secure by temporary bracing and nailing through sole plate into header/band joist.

5.2.12 Install bracing to exterior walls to resist lateral stresses when necessary. The learner will ascertain the conditions under which exterior wall bracing is unnecessary.

5.2.13 Layout, cut, fabricate and install all partition walls to a plum position.

> NOTE: IF TRUSS ROOF SYSTEM IS USED, THE FABRICATION AND INSTALLATION OF PARTITION WALLS MAY BE DELAYED UNTIL THE ROOF STRUCTURE IS FRAMED AND WATER TIGHT.

5.2.14 Layout, cut, and frame special purpose wall and floor openings as specified by drawings. (stair, furnace, air conditioner, recessed cabinet openings)

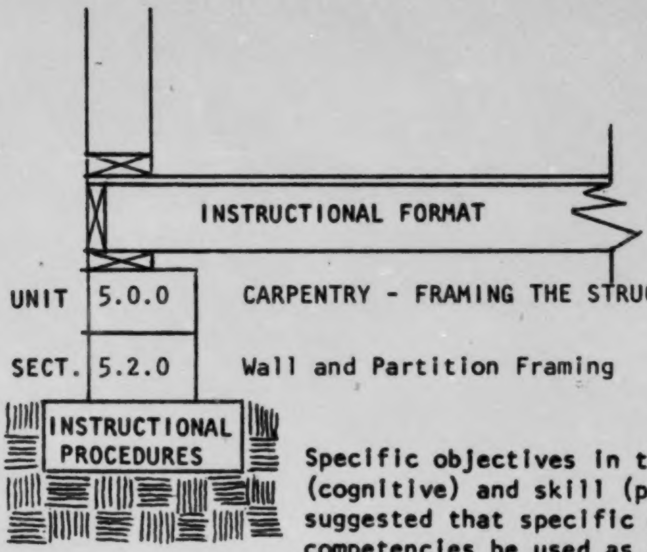
5.2.15 List five (5) materials/products generally used for wall sheathing purposes and write a primary advantage and disadvantage of each.

5.2.16 Compare five (5) commonly used sheathing materials by writing application techniques and procedures for each. Compare characteristics of size, lateral bracing value, application position, nailing details (spacing and size), and application techniques characteristic of each.

5.2.17 Install exterior wall sheathing according to accepted and efficient construction practices.

5.2.18 Calculate the maximum allowable span for ceiling joists of a particular species, grade, use and spacing from span tables published by the National Forest Products Association.

5.2.19 Layout, cut and install ceiling joists if truss roof construction is not used.



## INSTRUCTIONAL FORMAT

UNIT 5.0.0 CARPENTRY - FRAMING THE STRUCTURE

SECT. 5.2.0 Wall and Partition Framing

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of carpentry apprenticeship schools, residential construction firms and trade or labor organizations who can provide supplemental information about wall and partition framing.

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1 - Framing Openings in Exterior Walls
    2. TM 2 - Corner Post Assembly
    3. TM 3 - Corner Post Assembly (con't)
    4. TM 4 - Partition Intersections
    5. TM 5 - Framing openings in Exterior Walls
    6. TM 6 - Bracing a Wall Section
    7. TM 7 - Backing For Wash Basin
    8. TM 8 - Long Floor Register Opening
    9. TM 9 - Double Plate Installation At Corners
    10. TM 10 - Stair Types
    11. TM 11 - Stair Types (con't)
    12. TM 12 - Rough Stairwell - Framing Straight
    13. TM 13 - Rough Stairwell - Framing With Landing
    14. TM 14 - Winder Stairs
    15. TM 15 - Rise-Run Relationship in Stair Design
    16. TM 16 - Basic Types of Stair Risers
    17. TM 17 - Types of Stringers
    18. TM 18 - Ceiling Frame
- D. Assignment sheet #1 - Framing Terminology
- E. Answers to assignment sheet #1

IV. References:

A. Cooper, George H. and Stanley Badzinski, Jr. Building Construction Estimating. St. Louis, Missouri: McGraw Hill, 1971.

B. Durbahn, Walter E. and Robert E. Putnam. Fundamentals of Carpentry Tools, Materials and Practices. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

C. Durbahn, Walter E. and Elmer E. Sundberg. Fundamentals of Carpentry Practical Construction. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

D. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

E. Putnam, Robert E. and G. E. Carlson. Architectural and Building Trades Dictionary. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

F. Smith, Ronald C. Principles and Practices of Light Construction. Englewood Cliffs, New Jersey: Printice Hall Inc., 1970.

G. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

# WALL AND PARTITION FRAMING
## SECTION 5.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Wall frame members

  A. Sole plates

  B. Top plates

  C. Studs

  D. Stud spacing

  E. Opening frame parts

    1. Cripple studs

    2. Trimmer studs

    3. Header (lintel)

    4. Rough sill

II. Corner construction

  A. Three full studs with blocking

  B. Three full studs without blocking

  C. Three full studs with filler strips

III. Partition intersections

  A. Three extra studs in outside wall

  B. Blocking between regular stud spaces

IV. Window and door opening framing

  A. Header size (see span tables)

  B. Wide span or extra load provisions

  C. Header construction

1. Spacers
2. Nailing specifications

V. Wall plate layout
A. Stock selection
B. Length criteria
1. Rough opening
2. Installation procedures
C. Layout techniques
1. Mark regular stud spacing (x)
2. Opening center lines (¢)
3. Trimmer studs (T)
4. Regular stud next to trimmer (x)
5. Cripple studs (c)
6. Intersecting partitions
D. Master stud pattern (story pole)

VI. Wall section construction
A. Pre-cut regular studs (P.E.T.)
B. Header fabrication
C. Wall assemble fabrication procedure
1. Plate positions
2. Full length stud installation
3. Trimmer stud installation
4. Header installation
5. Upper cripples installation
6. Rough sill installation
7. Lower cripples installation

8. Partition intersections

9. Optional sheathing application

VII. Wall section erection

A. Pre-preparation

1. Location layout
2. Bracing provisions
3. Manpower
4. Diagonal wall bracing

B. Installation procedures

1. Bracing
2. Final sole plate adjustments
3. Sole plate nailing
4. Plumbing

VIII. Partition wall installation

A. Conditions

1. Load bearing partitions
2. Roof type

B. Installation procedures

1. Center line layout
2. Wall construction procedures
3. Erection order
   a. Long
   b. Cross
   c. Short

IX. Special purpose wall and floor openings

- A. Bath partition wall
- B. Closet partition wall
- C. Soundproofing
- D. Heating ducts
- E. Bath tub blocking
- F. Wall bracing
- G. Recessed cabinets
- H. Corner blocks
- I. Stairs
- J. Return air ducts (supply air)
- K. Air conditioners

X. Exterior wall bracing

- A. Purpose
- B. Types
  - 1. Plywood
  - 2. Let-in corner bracing
  - 3. Metal
  - 4. Double plate
    - a. Corner lap
    - b. Joint separation

XI. Wall sheathing

- A. Purposes
  - 1. Strength
  - 2. Rigidity

B. Plywood
   1. Bracing value
   2. Sizes
   3. Thickness minimums
   4. Application direction
   5. Sheathing grade
   6. Nailing (6-12-6d)

C. Fiberboard
   1. Bracing value
   2. Sizes
   3. Thickness
   4. Application direction
   5. Nailing (3-6-1 1/2 / 1 3/4 roof)

D. Gypsum
   1. Bracing value
   2. Sizes
   3. Thickness
   4. Application direction
   5. Nailing (4-8-1 3/4)

E. Wood boards
   1. Bracing value
   2. Maximum width
   3. Thickness
   4. Application direction
   5. Nailing
      a. 8 inch widths (two 8d)
      b. Over 8 inch width (three 8d)

        6. Other milled wood products
            a. Edge and end matched
            b. Shiplap

XII. Wall sheathing application procedures
    A. Timing sequence
    B. Opening procedures

XIII. Ceiling framing - non-truss construction
    A. Similarity to floor framing
    B. Spans from tables
    C. Spacing
    D. Dead load
    E. Live load
    F. Installation direction
    G. Special construction procedures
        1. Extra long spans
            a. Built-up-beam
            b. Trussed beam
            c. Roof trusses
        2. Changes in direction of ceiling joists
            a. Reduce span
            b. Low pitch rafter clearance
    H. Anchoring partitions parallel to ceiling frame
        1. Right angles to ceiling joists
        2. Parallel to ceiling joists

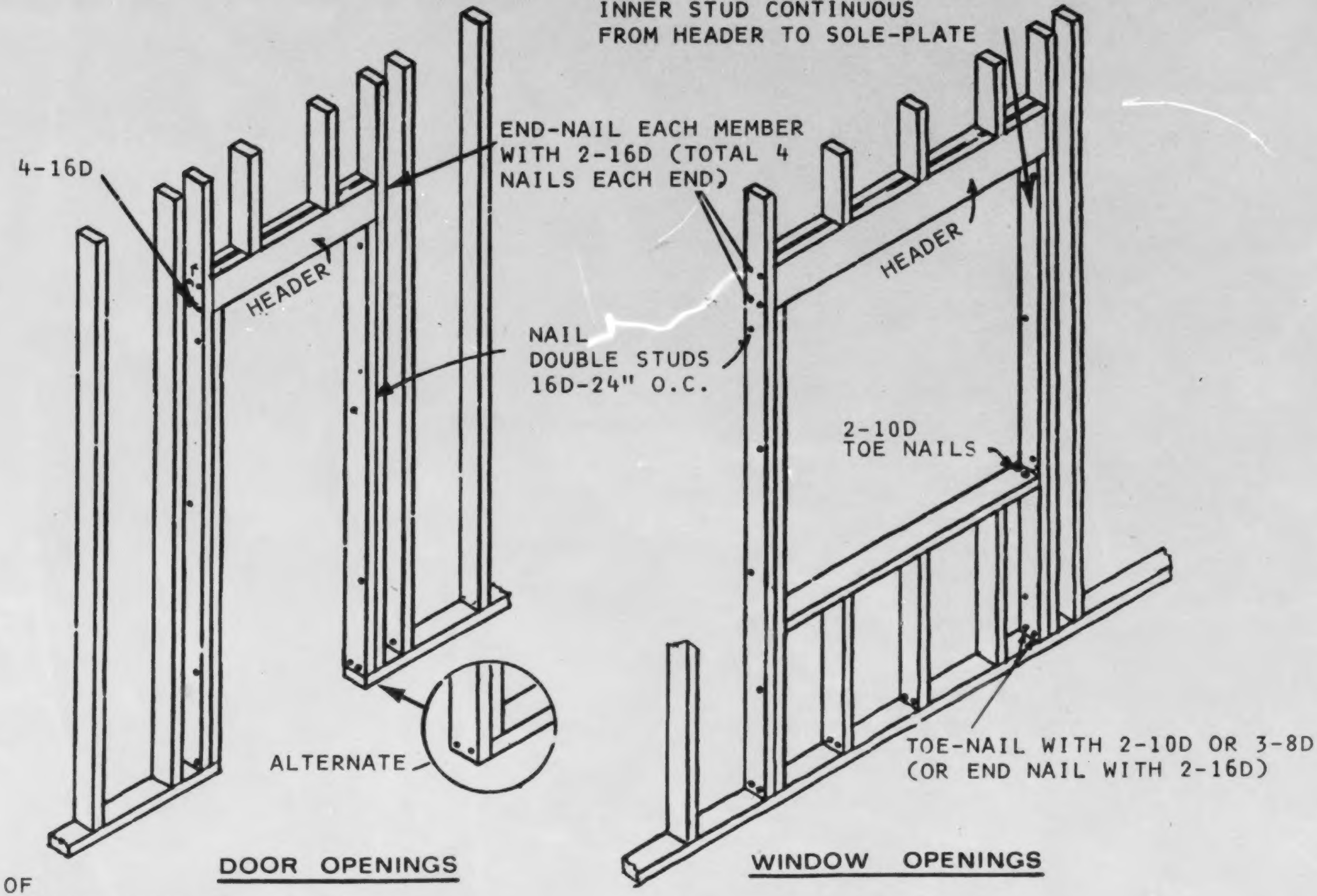
a. Blocking

b. Nailer

I. Installation procedures

1. Plate layout
2. Positioning for nailing to rafters
3. Nailing (two 10d toe, each side)
4. Ceiling openings

# FRAMING OPENINGS IN EXTERIOR WALLS


4-16D
END-NAIL EACH MEMBER WITH 2-16D (TOTAL 4 NAILS EACH END)
INNER STUD CONTINUOUS FROM HEADER TO SOLE-PLATE
HEADER
HEADER
NAIL DOUBLE STUDS 16D-24" O.C.
2-10D TOE NAILS
ALTERNATE
TOE-NAIL WITH 2-10D OR 3-8D (OR END NAIL WITH 2-16D)

DOOR OPENINGS

WINDOW OPENINGS

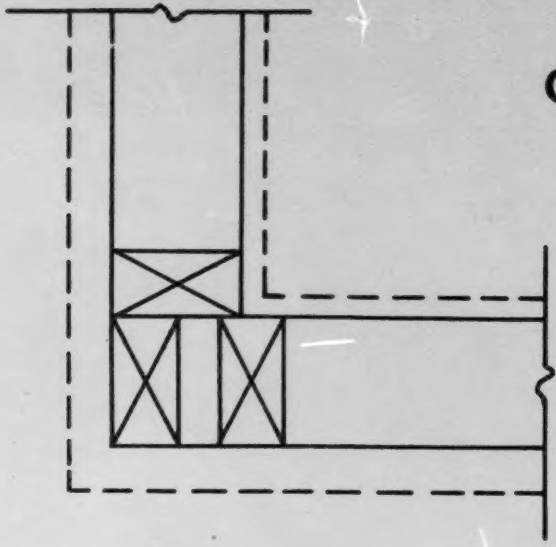
5.2.0 - TM 1

COURTESY OF
FEDERAL HOUSING AUTHORITY
MINIMUM PROPERTY STANDARDS

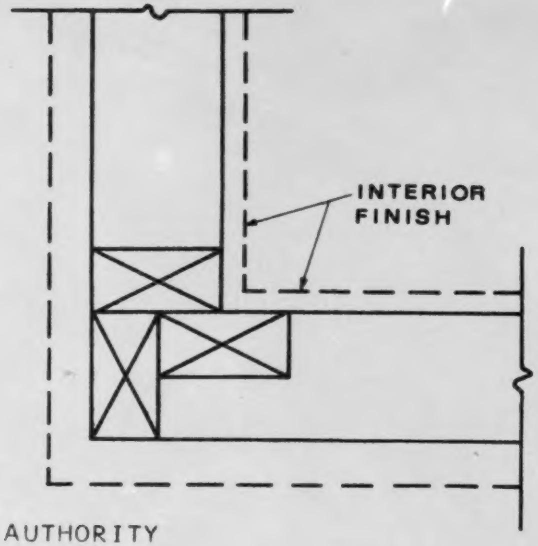
IML-UMC
336

# CORNER POST ASSEMBLY

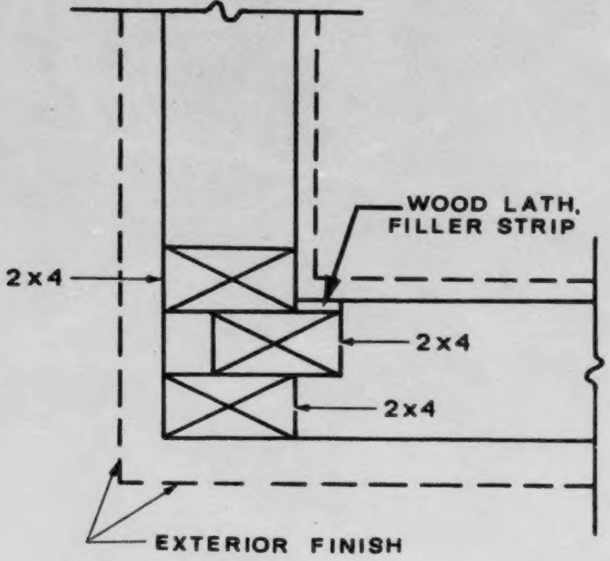
(1)



(2)



(3)



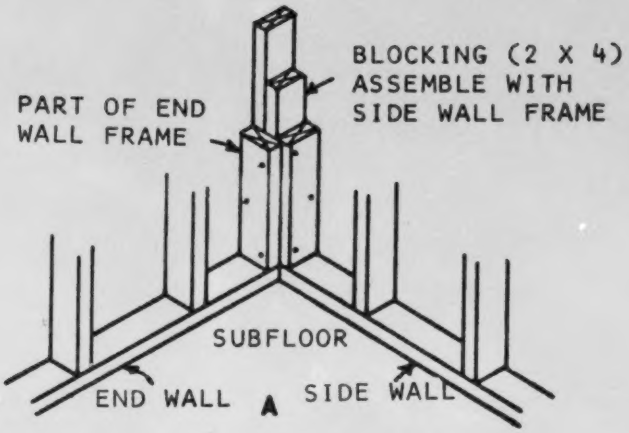
NAIL CORNER STUDS TOGETHER TO FORM SINGLE UNIT USING 16D NAILS @ 24" O.C. STAGGERED. AT LEAST THREE ADDITIONAL 16D NAIL SHALL BE PLACED IN EACH FILLERBLOCK.

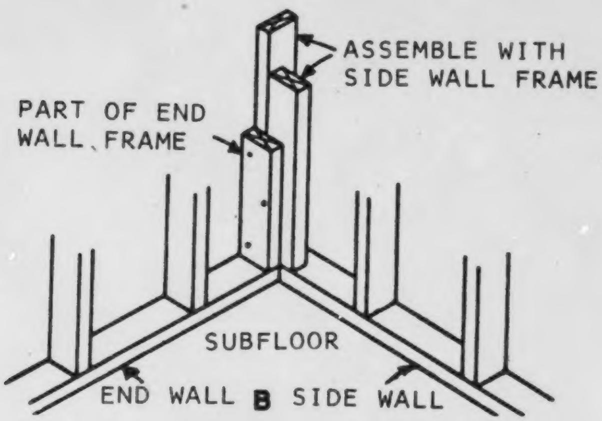
5.2.0 - TM 2

COURTESY OF
FEDERAL HOUSING AUTHORITY
MINIMUM PROPERTY STANDARDS

IML-UMC

# CORNER POST ASSEMBLY

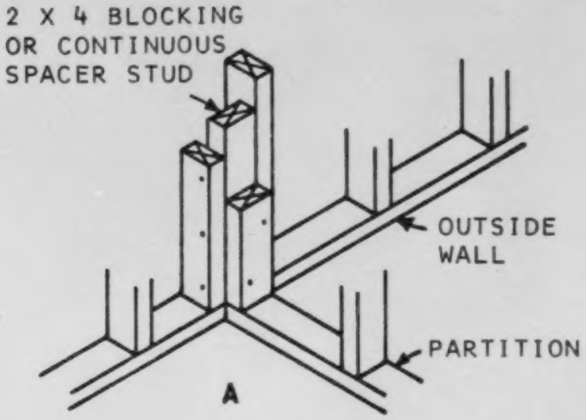




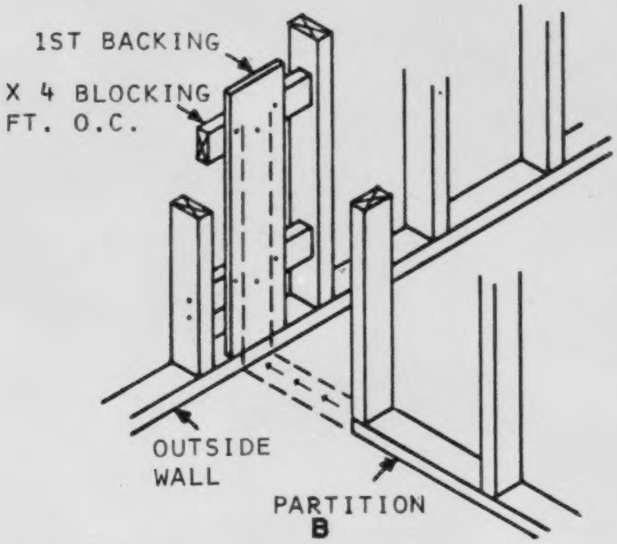
A- FORMED WITH THREE FULL STUDS AND BLOCKING
B- FORMED WITH THREE FULL STUDS. NO BLOCKING REQUIRING

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY

# PARTITION INTERSECTIONS



A

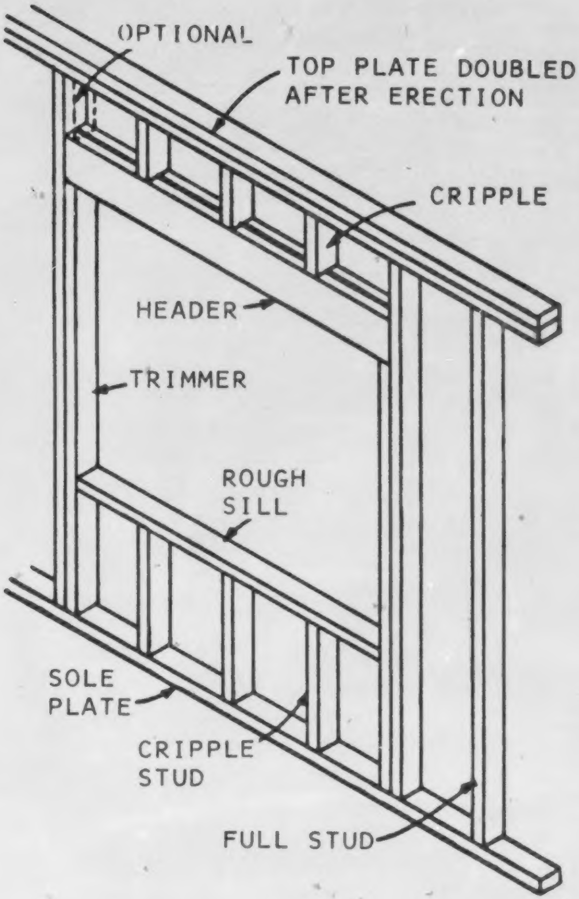


B

A- USING EXTRA STUDS. NAIL THE WALL STUDS TO THE SPACERS WITH 16D NAILS SPACED 12 IN. O.C. USE 10D NAILS TO ATTACH THE PARTITION STUD.
B- USING BLOCKING BETWEEN THE REGULAR STUD SPACES. INSTALL THE 2 X 4 BLOCKING WITH 16D NAILS. USE 8D NAILS TO ATTACH THE BACKING BOARD.

GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
IML-UMC

# A TYPICAL WALL FRAME AT A WINDOW OPENING



342

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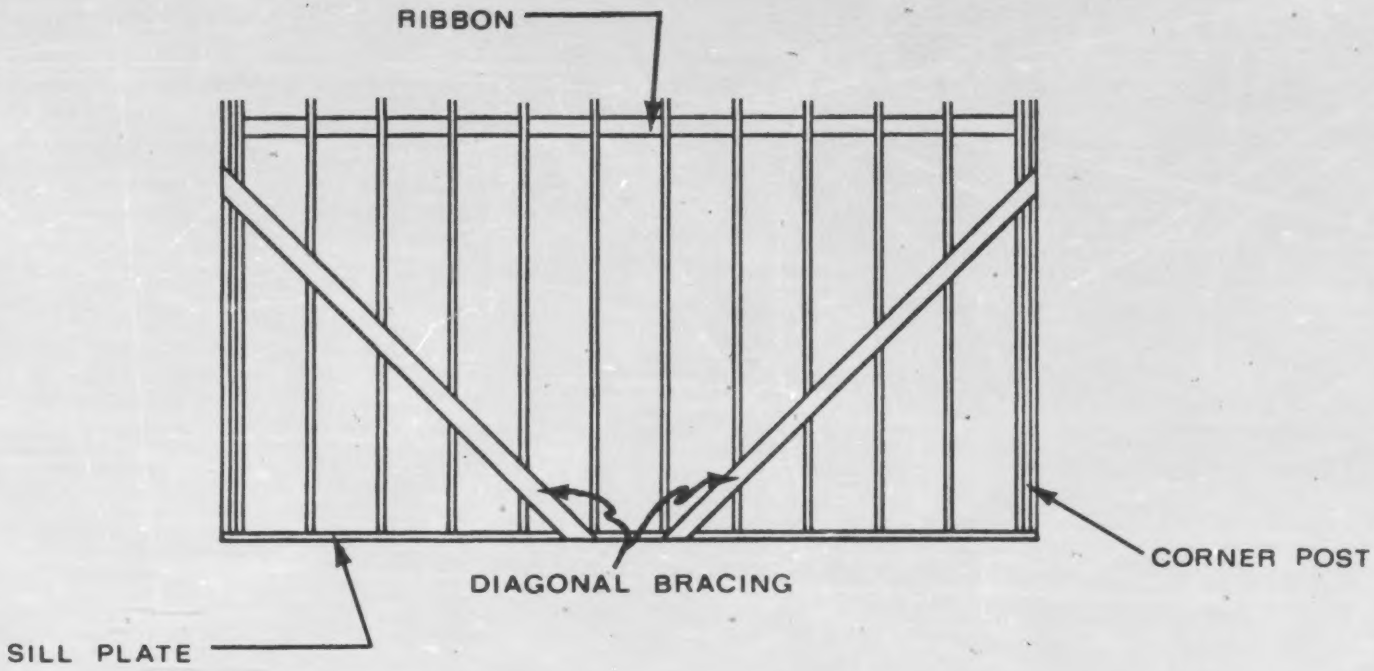
MODERN CARPENTRY BY
WILLIS H. WAGNER
IML-UMC

# BRACING A WALL SECTION

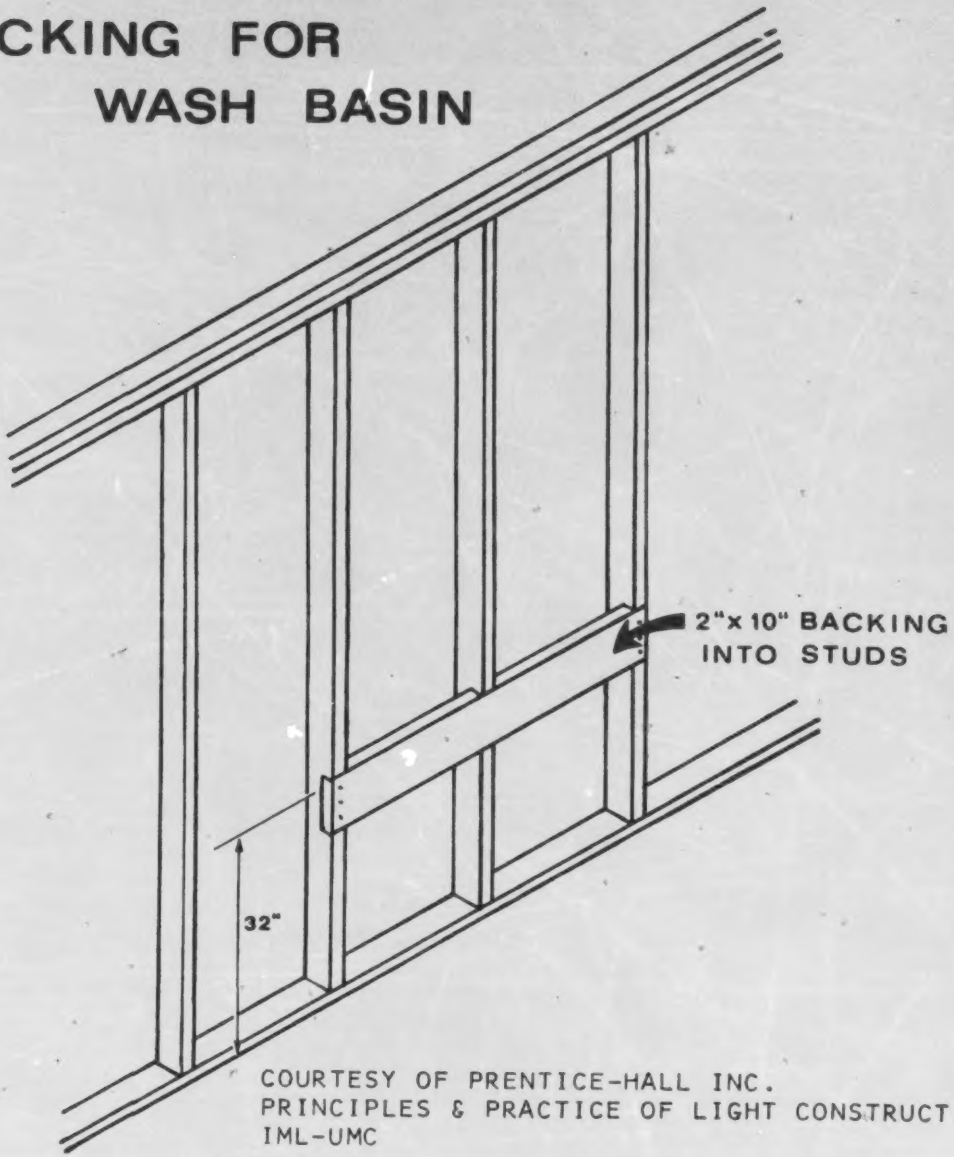


5.2.0 - TM 6

IML-UMC

By courtesy of Delmar Publishers, A Division of
Litton Educational Publishing, Inc., Albany, NY 12205

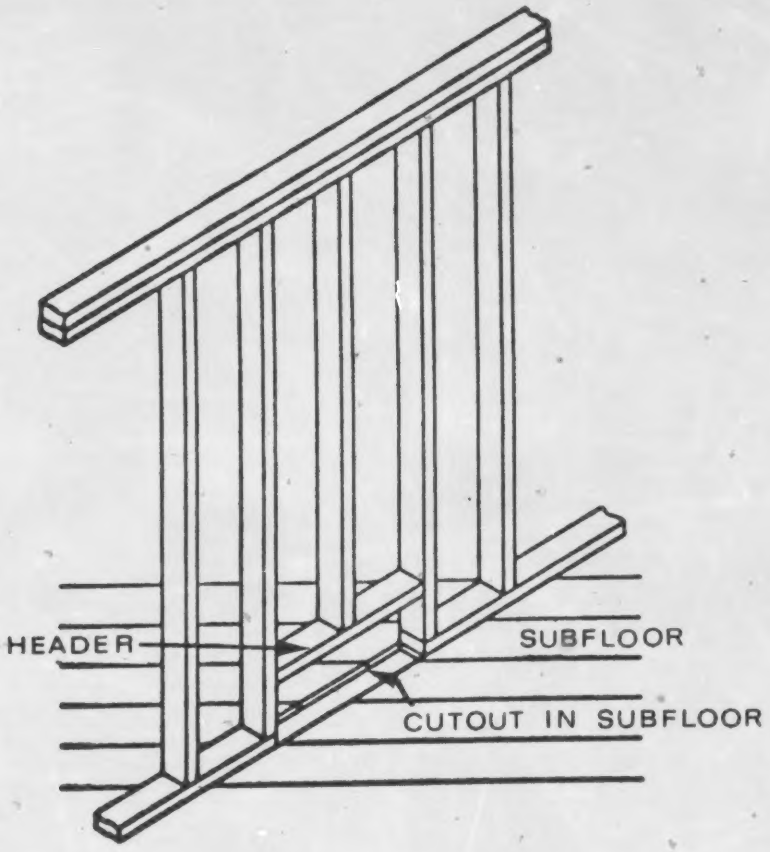
# BACKING FOR WASH BASIN



COURTESY OF PRENTICE-HALL INC.
PRINCIPLES & PRACTICE OF LIGHT CONSTRUCTION
IML-UMC

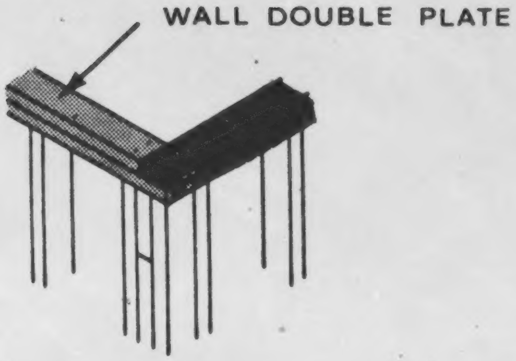
5.2.0 - TM 7

# LONG FLOOR REGISTER OPENINGS

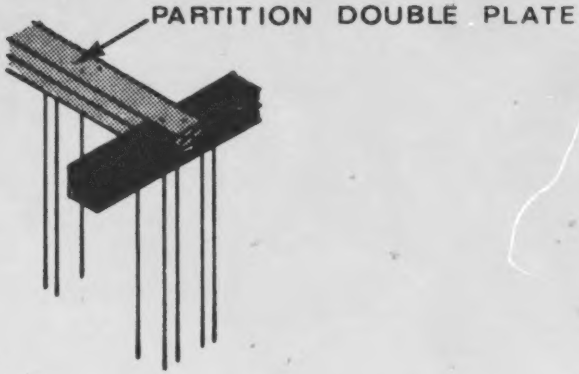


COURTESY OF
PRENTICE-HALL INC.
PRINCIPLES & PRACTICES OF
LIGHT CONSTRUCTION
IML-UMC

# DOUBLE PLATE INSTALLATION AT CORNERS



WALL CORNER



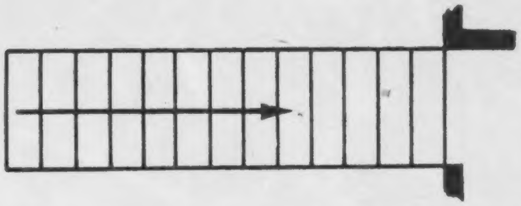
INTERSECTING PARTITION

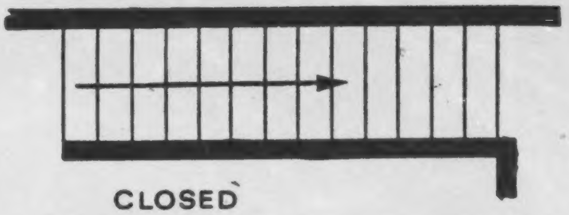
COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
IML-UMC

5.2.0 - TM 9

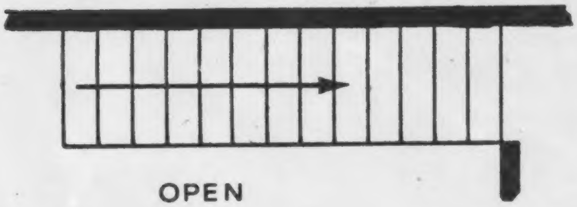
# STAIR TYPES

## OPEN AND CLOSED STAIRS

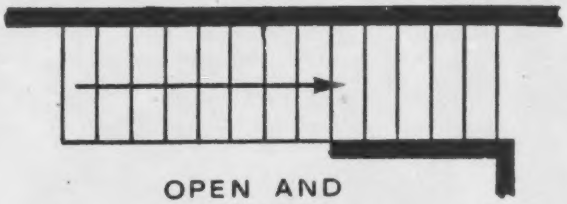




**CLOSED**

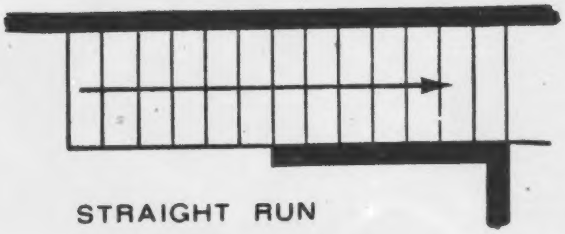


**OPEN**

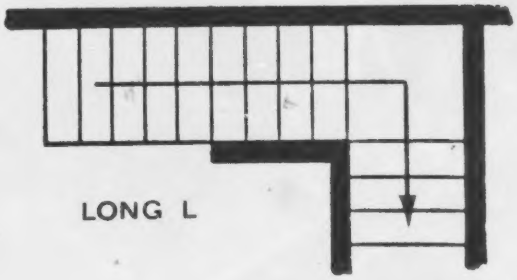


**OPEN AND CLOSED**

THE TERM "OPEN STAIRS" APPLIES EVEN THOUGH A WALL IS LOCATED ON ONE SIDE.



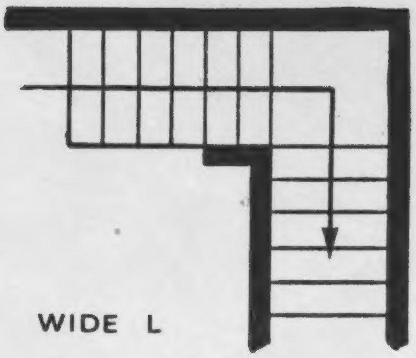
**STRAIGHT RUN**



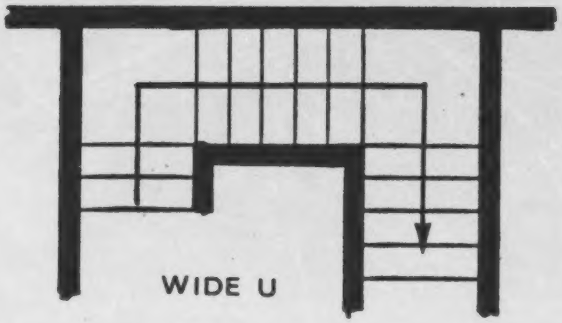
**LONG L**

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER

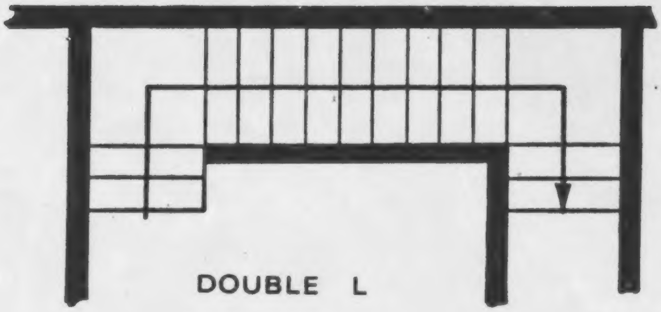
# STAIR TYPES



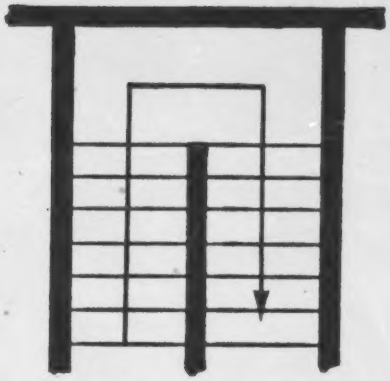
WIDE L



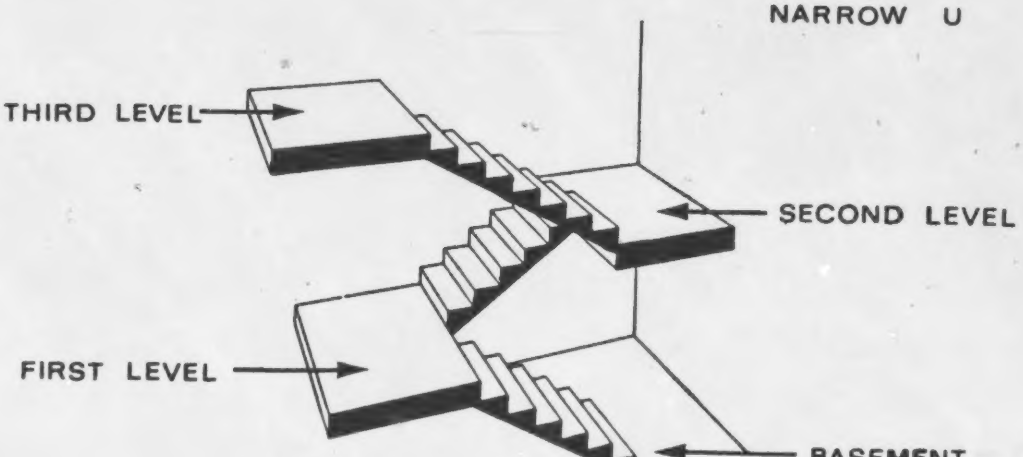
WIDE U



DOUBLE L



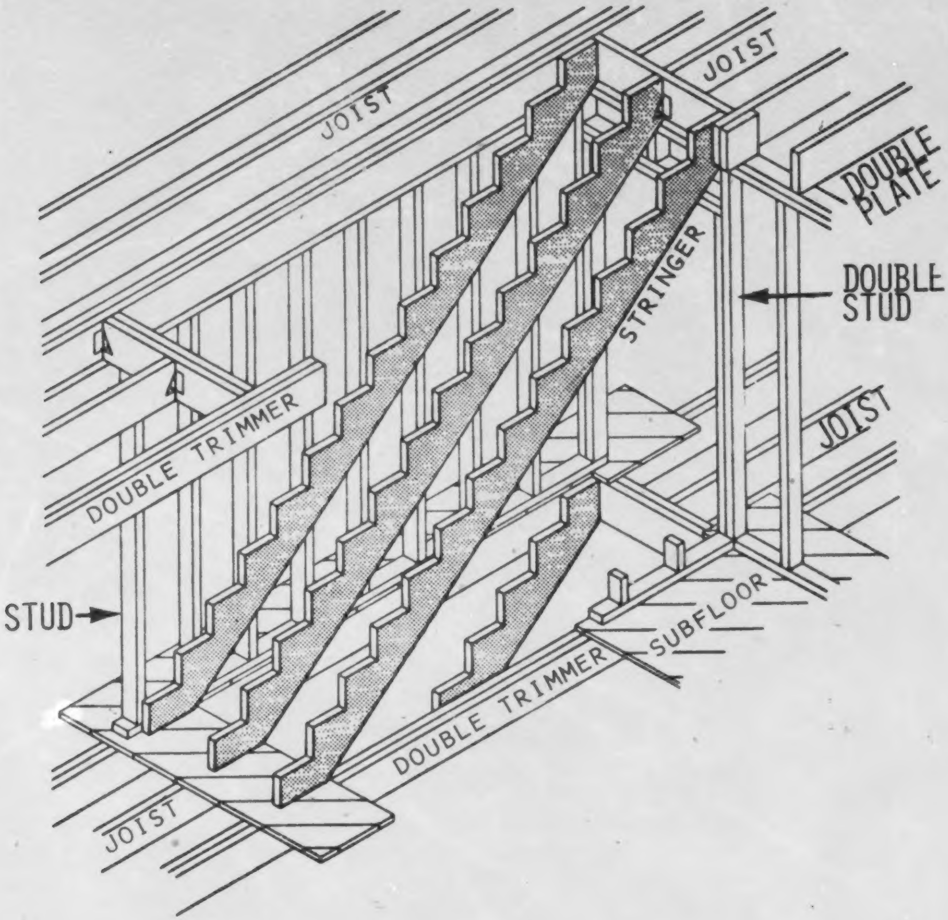
NARROW U



SPLIT-LEVEL DESIGN

COURTESY OF GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY WILLIS H. WAGNER
IML-UMC

# ROUGH STAIRWELL - FRAMING STRAIGHT RUN



COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
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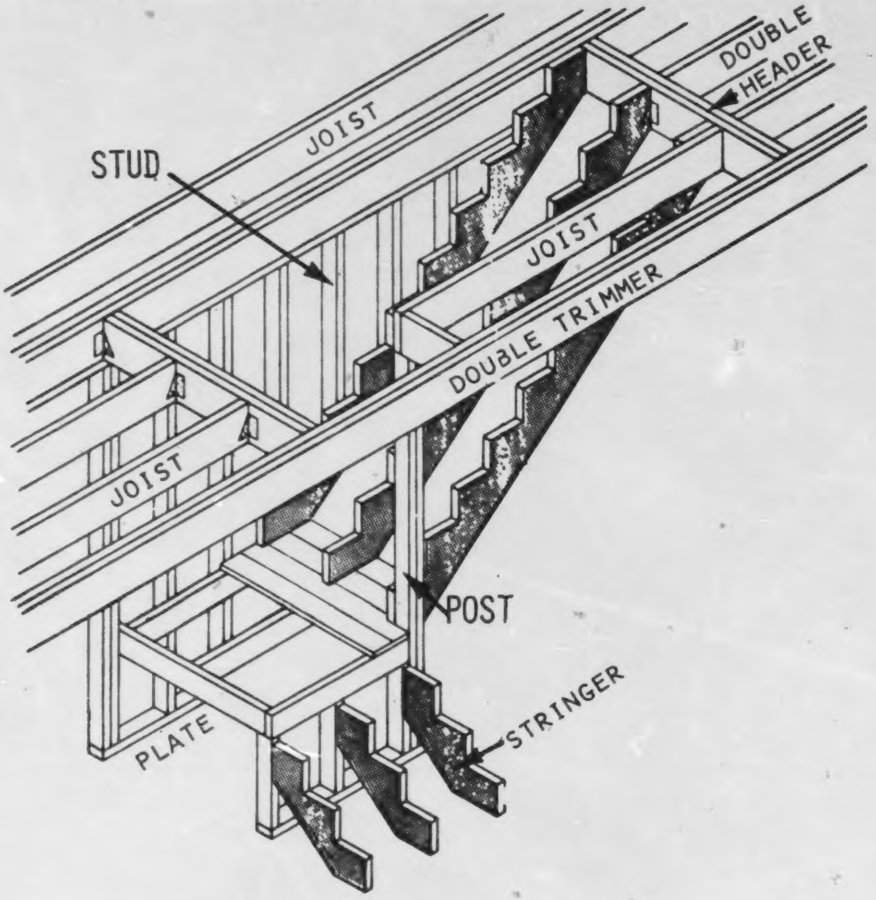
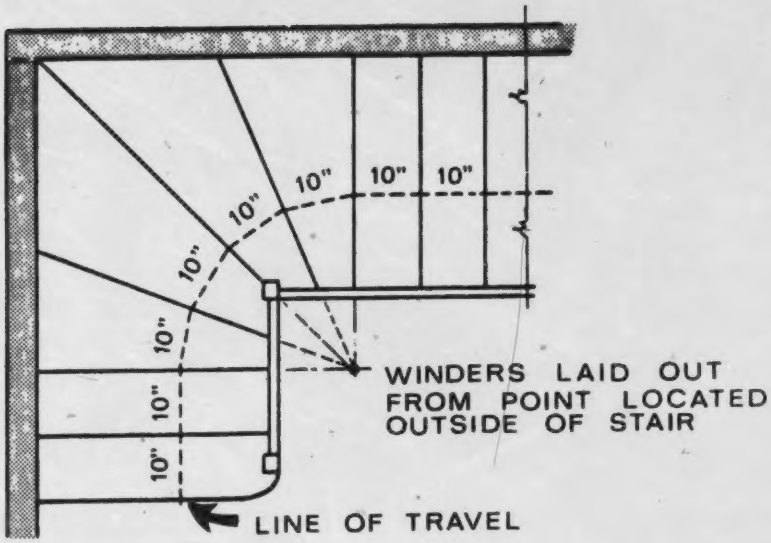
# ROUGH STAIRWELL-FRAMING WITH LANDING



COURTESY OF:
GOODHEART-WILLCOX COMPANY
MODERN CARPENTRY

IML-UMC

# WINDER STAIRS



COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
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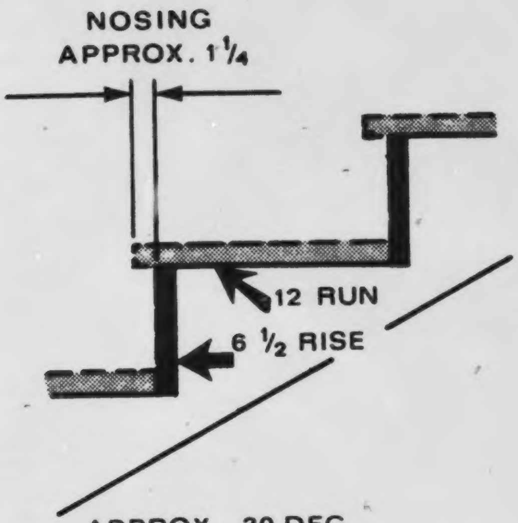
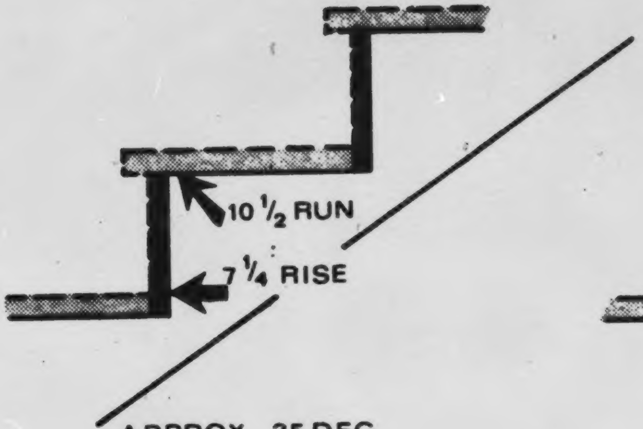
# RISE-RUN RELATIONSHIPS IN STAIR DESIGN



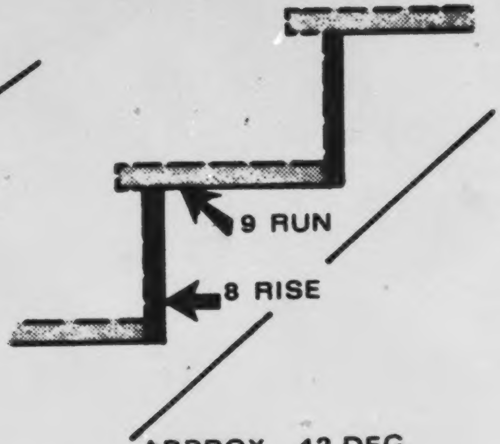
APPROX. 30 DEG.

$(6\frac{1}{2} + 6\frac{1}{2}) + 12 = 25$



APPROX. 35 DEG.

$(7\frac{1}{4} + 7\frac{1}{4}) + 10\frac{1}{2} = 25$



APPROX. 42 DEG.

$(8 + 8) + 9 = 25$

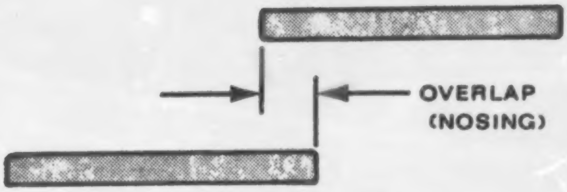
GENERAL RULE:

THE SUM OF 2 RISERS + 1 TREAD SHOULD EQUAL 25 IN.

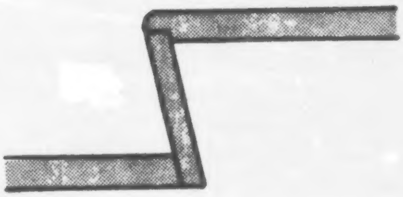
5.2.0 - TM 15

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY
IML-UMC

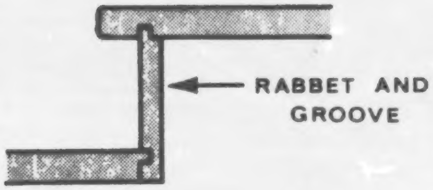
# BASIC TYPES OF STAIR RISERS



OPEN



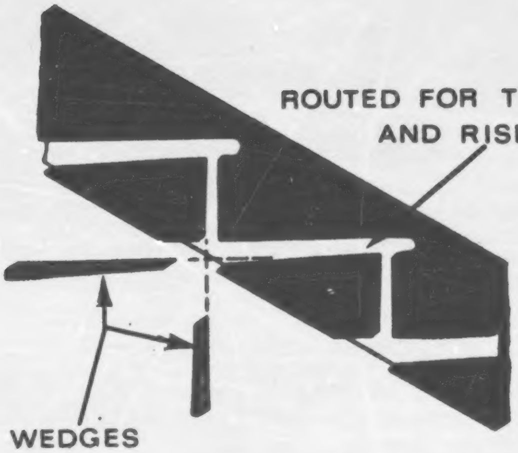
SLOPING



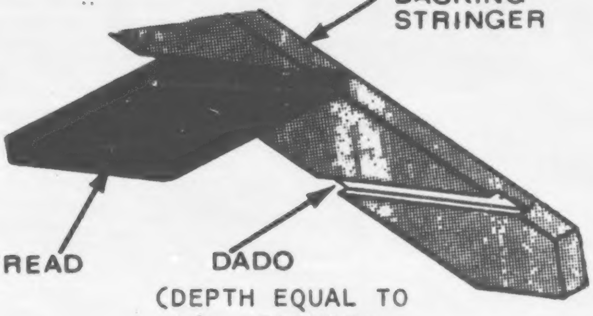
VERTICAL

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER IML-UMC

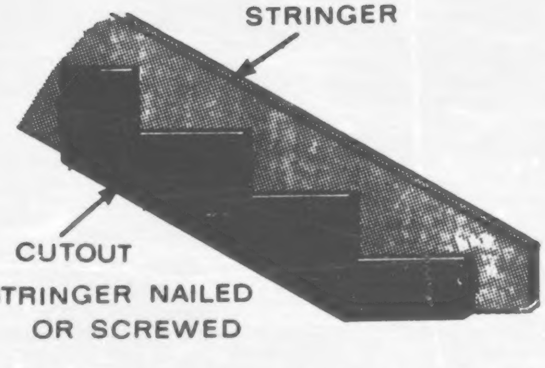
# TYPES OF STRINGERS



HOUSED STRINGER DESIGN



OPEN RISERS WITH TREADS SET INTO DADOS



SEMI-HOUSED STRINGER DESIGN

COURTESY OF
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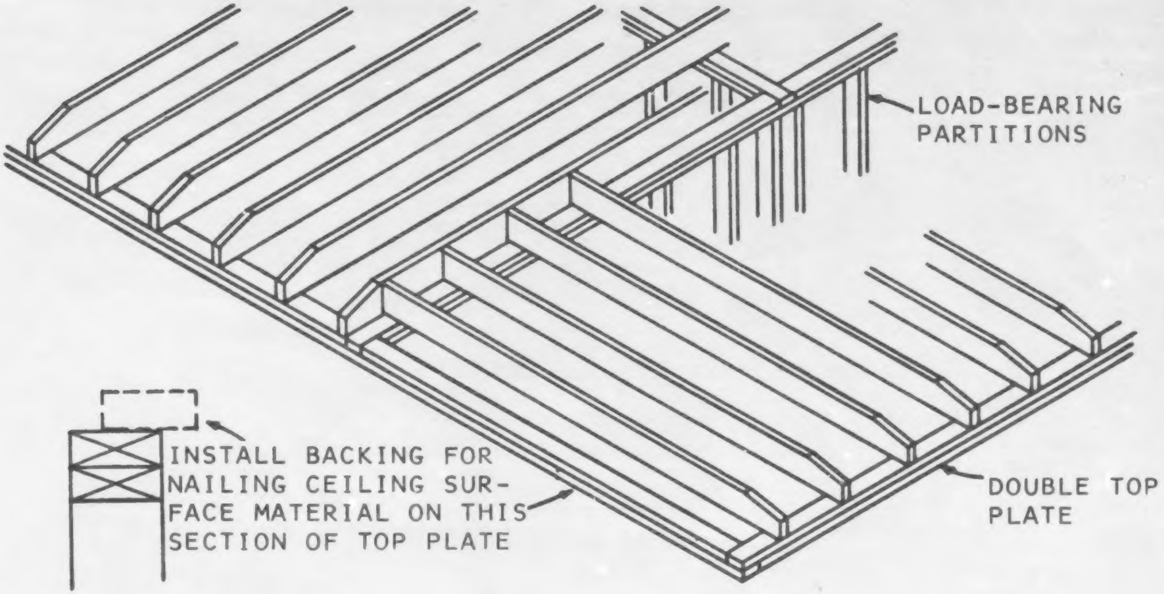
# CEILING FRAME


LOAD-BEARING PARTITIONS
INSTALL BACKING FOR NAILING CEILING SURFACE MATERIAL ON THIS SECTION OF TOP PLATE
DOUBLE TOP PLATE

JOISTS IN FOREGROUND ARE TURNED AT A RIGHT ANGLE TO REDUCE THE SPAN.

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
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# WALL AND PARTITION FRAMING
## SECTION 5.2.0

## ASSIGNMENT SHEET #1 - FRAMING TERMINOLOGY

Write the names of the wall and partition framing members in the illustration below.

A.

B.

C.

D.

E.

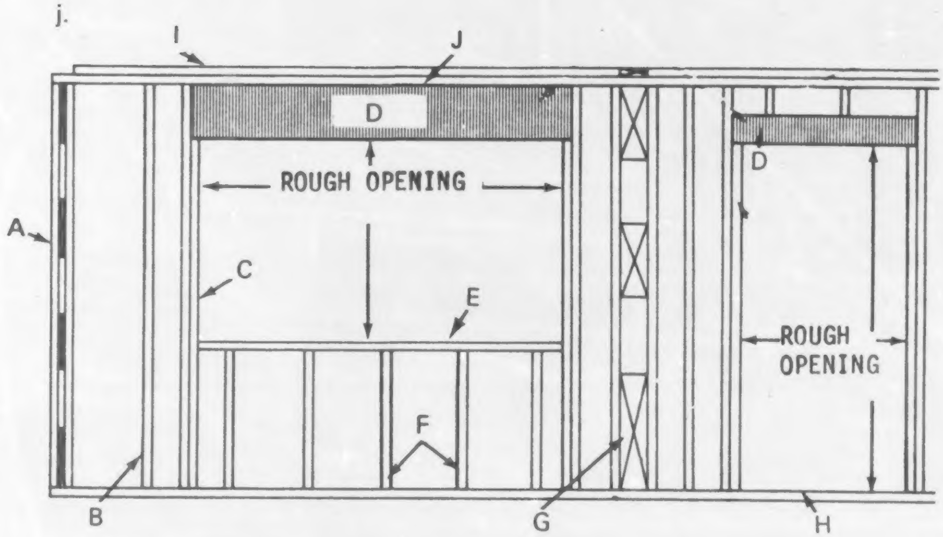
F.

G.

H.

I.

J.



## WALL AND PARTITION FRAMING
## SECTION 5.2.0

### ANSWERS TO ASSIGNMENT #1

A. Corner assembly

B. Regular stud

C. Trimmer stud

D. Headers

E. Rough sill

F. Cripple studs

G. Blocking

H. Sole plate

I. Double top plate

J. Top plate

## STATEMENT OF OBJECTIVES

UNIT 5.0.0 CARPENTRY - FRAMING THE STRUCTURE

SECT. 5.3.0 Roof Framing

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL IDENTIFY ROOF FRAME MEMBERS AND ROOF STYLE, DEFINE ROOF FRAMING TERMS; LAYOUT, CUT AND ASSEMBLE VARIOUS ROOF MEMBERS; LAYOUT, CUT AND FABRICATE COMMONLY USED W TRUSSES; LIST COMMONLY USED ROOF SHEATHING MATERIALS; CALCULATE OTHER VENTILATION REQUIREMENTS AND INSTALL FASCIA AND GABLE TRIM.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

5.3.1 Sketch, in pictorial fashion, and identify seven (7) types of roofs used in residential construction.

5.3.2 Sketch a composite plan view of a roof and identify six (6) kinds of roof rafters. Include ridges, and gables as needed.

5.3.3 Sketch in pictorial form all parts of a common rafter and identify each part by label.

5.3.4 Define the roof framing terms span, run, rise, ridge, rafter length, slope, and pitch in writing.

5.3.5 Lay off rafter locations on top and edge of exterior wall plates and on both faces of the ridge board.

5.3.6 Layout, cut, and erect common rafters and ridge board.

5.3.7 Layout, cut and fit gable end studs if applicable.

NOTE: AN ALTERNATE PROCEDURE IS TO FRAME THE COMPLETE GABLE END RAFTERS AND STUDS AS ONE OR TWO UNITS.

5.3.8 Layout, cut and install horizontal framing members over and at right angles to the gable if an extended roof rake (gable overhang) is included in the architectural plans.

NOTE: GABLE END HEIGHT IS REDUCED BY AN AMOUNT EQUAL TO THE WIDTH OF THE ROOF RAFTERS MEASURED AT RIGHT ANGLES TO THE PLANE IN WHICH THE ROOF RAFTERS LIE.

5.3.9 Layout, cut and install hip and valley rafters if applicable to the roof design.

5.3.10 Layout, cut and install hip jack rafters.

5.3.11 Layout, cut and install valley jack rafters.

5.3.12 Layout, cut and install cripple jack rafters.

5.3.13 Layout, cut and fit fascia to rafter tails and rake on gable ends when applicable.

5.3.14 Layout, cut and fabricate the standard W (Fink) truss commonly used in residential construction. The truss will be built from engineering data provided by the University of Illinois Small Homes Councils "Nail-Glued "W" Roof Truss, 2" x 4" Truss, 2' on Center, 20' - 8" to 28" - 8" spans, 4/12 Slope".

5.3.15 List three (3) roof sheathing materials/products generally used and write a primary advantage and disadvantage of each.

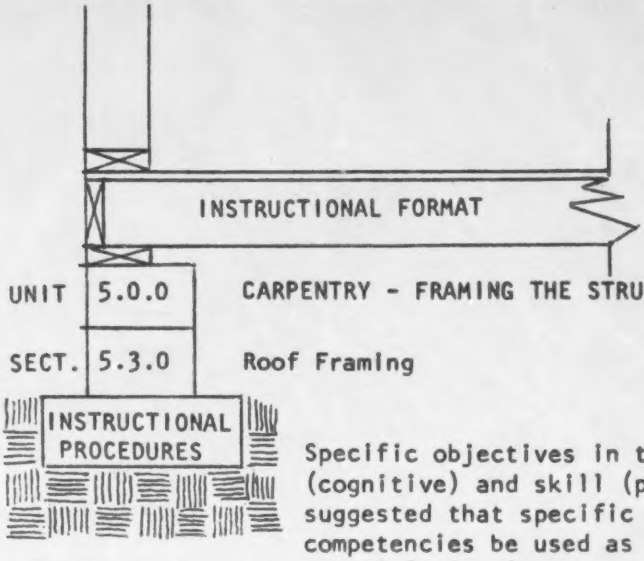
5.3.16 Compare three (3) commonly used roof sheathing material products by writing application techniques and procedures for each. Compare characteristics of size, bracing value, application techniques characteristic of each.

5.3.17 Calculate the amount (net free area) of attic ventilation needed as specified by HUD Minimum Property Standards for One and Two Family Dwellings for a 1500 sq. ft. single story residential structure.

5.3.18 Install roof sheathing according to local building codes or HUD Minimum Property Standard construction practices.

NOTE: REMEMBER TO LEAVE A CONTINUOUS OPENING IN THE SHEATHING AT THE RIDGE IF ATTIC VENTILATION REQUIREMENTS ARE MET BY USE OF RIDGE VENTILATION. SEE VENTILATOR RIDGE INSTALLATION INSTRUCTIONS.

5.3.19 Layout, cut and fit finish trim (corner or plain molding) to gable end roof rakes.



## INSTRUCTIONAL FORMAT

UNIT 5.0.0 **CARPENTRY - FRAMING THE STRUCTURE**

SECT. 5.3.0 Roof Framing

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of carpentry apprenticeship programs, residential construction firms and trade associations or labor organizations who can provide supplemental information about roof framing.

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    1. TM 1 - Plan View of Roof Frames (see 1.6.0 - TM 15)
    2. TM 2 - Types of Roofs
    3. TM 3 - Rafters
    4. TM 4 - Laying Out a Common Rafter By The Step-Off Method
    5. TM 5 - Framing The Studs For a Gable End
    6. TM 6 - Hip Rafters
    7. TM 7 - Layout of a Hip Rafter
    8. TM 8 - Framing a Hip or Intersecting Roof
    9. TM 9 - Hip Jack Rafters - Common Difference
    10. TM 10 - Establishing Rafter Lengths In Unit Measurements
    11. TM 11 - Securing Roof Rafters to Ridge and Plate
    12. TM 12 - Standard W or Fink Truss
    13. TM 13 - Methods of Ventilating Roof Spaces and Amount of Ventilation Required
- C. Assignment sheet #1 - Compute Rafter Length
- D. Assignment sheet #2 - Estimate Roof Framing Materials
- E. Answers to assignment sheets #1 and #2

IV. References:

- A. Cooper, George H. and Stanley Badzinski, Jr. *Building Construction Estimating*. St. Louis, Missouri: McGraw Hill, 1971.
- B. Durbahn, Walter E. and Robert E. Putnam. *Fundamentals of Carpentry Tools, Materials and Practices*. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

C. Durbahn, Walter E. and Elmer E. Sundberg. Fundamentals of Carpentry Practical Construction. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

D. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

E. Putnam, Robert E. and G. E. Carlson. Architectural and Building Trades Dictionary. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

F. Smith, Ronald C. Principles and Practices of Light Construction. Englewood Cliffs, New Jersey: Printice Hall Inc., 1970.

G. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

## ROOF FRAMING
## SECTION 5.3.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Roof types
  A. Flat
  B. Shed
  C. Gable
  D. Hip
  E. Gambrel
  F. Mansard
  G. Butterfly

II. Roof frame parts
  A. Rafter type
    1. Common
    2. Hip
    3. Valley
    4. Jack rafters
      a. Hip jack
      b. Valley jack
      c. Cripple jack
  B. Ridge
  C. Gable

III. Common rafter parts
  A. Ridge cut (plumb cut)

B. Seat cut and plumb cut ( bind's mouth)

C. Rafter tail

D. Tail cut

IV. Roof framing terms

A. Span

B. Run

C. Rise

D. Ridge

E. Rafter length

F. Slope

G. Pitch

V. Rafter spacing layout

A. Spacing distances

B. Coordination with ceiling joist

C. Initial rafter layout distance

VI. Gable end framing

A. Spacing

B. Notching

VII. Gable end framing with extended roof rake

A. Gable end height adjustment

B. Ladder construction

VIII. Hip and valley rafter layout

A. Framing square tables

B. Common rafter installation

C. Hip and valley layout and installation

D. Jack rafter layout and installation

1. Hip jacks

2. Valley jacks

3. Cripple jacks

IX. Fascia board and roof rake trim

X. Truss roof construction

A. Advantages

1. Strength

2. Wide span possibilities

3. Larger rooms

4. Flexible partition wall placement

5. Possible reduced labor cost

B. Standard W (Fink truss)

1. Specifications

2. Part names

a. Bottom chord

b. Top chord

c. Tension web

d. Compression web

e. Plates and connectors

XI. Roof sheathing

A. Plywood

1. Advantages

    - a. Installation speed
    - b. Nail holding quality
    - c. Swelling and shrinkage
    - d. Rigidity
  - 2. Installation specifications
    - a. Thickness and rafter span relationship
    - b. Nailing (6d - 6 - 12)
    - c. Application directions
    - d. End joint placement
- B. Shiplap or common boards
  - 1. Application direction
  - 2. End joint placement
  - 3. Size
  - 4. Nailing
    - a. Size
    - b. Number
- C. Special sheathing materials

XII. Attic ventilation

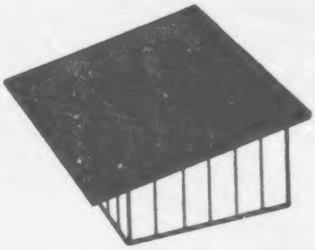
- A. Purpose
- B. Ventilation requirements
  - 1. Gable roof (1/300 x total sq. ft. + net free area of attic ventilation)
  - 2. Other roof types
- C. Location of ventilation openings
  - 1. Ridge
  - 2. Gable ends

3. Soffit or plancier

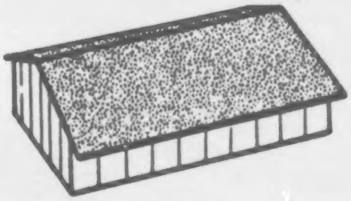
4. Roof vents

XIII. Roof rake finish trim

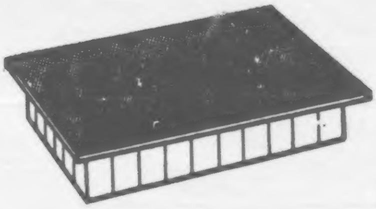
# TYPES OF ROOFS



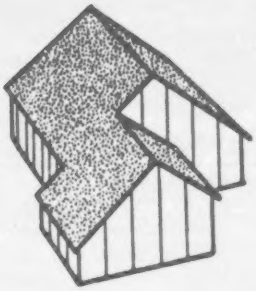
SHED ROOF



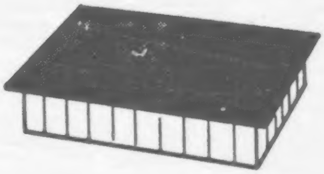
GABLE ROOF



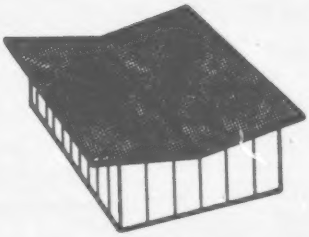
FLAT ROOF



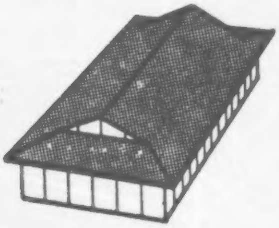
CONTINUOUS SLOPE GABLE



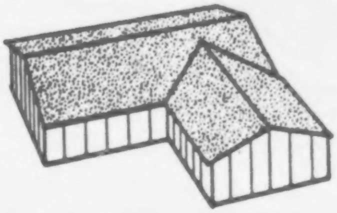
HIP ROOF



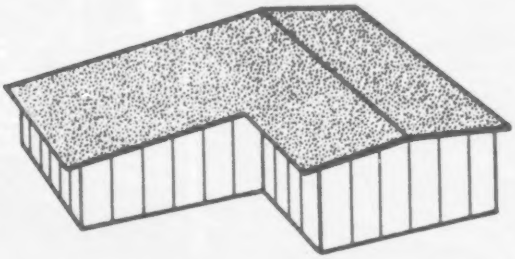
BUTTERFLY ROOF



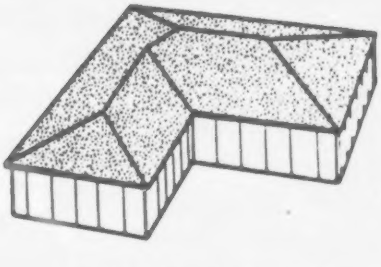
"DUTCH" HIP ROOF



L-SHAPED GABLE ROOF



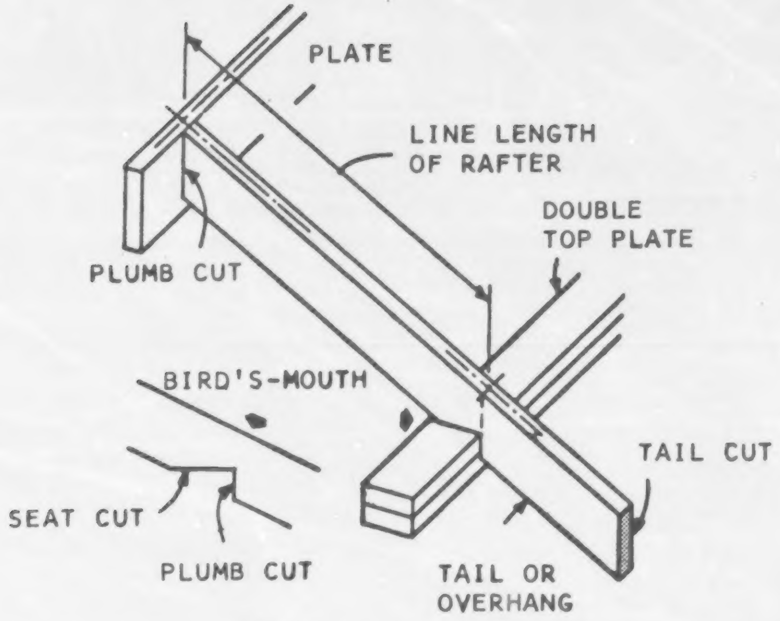
CONTINUOUS LOW SLOPE GABLE



L-SHAPED HIP ROOF

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

# RAFTERS



PARTS OF A RAFTER

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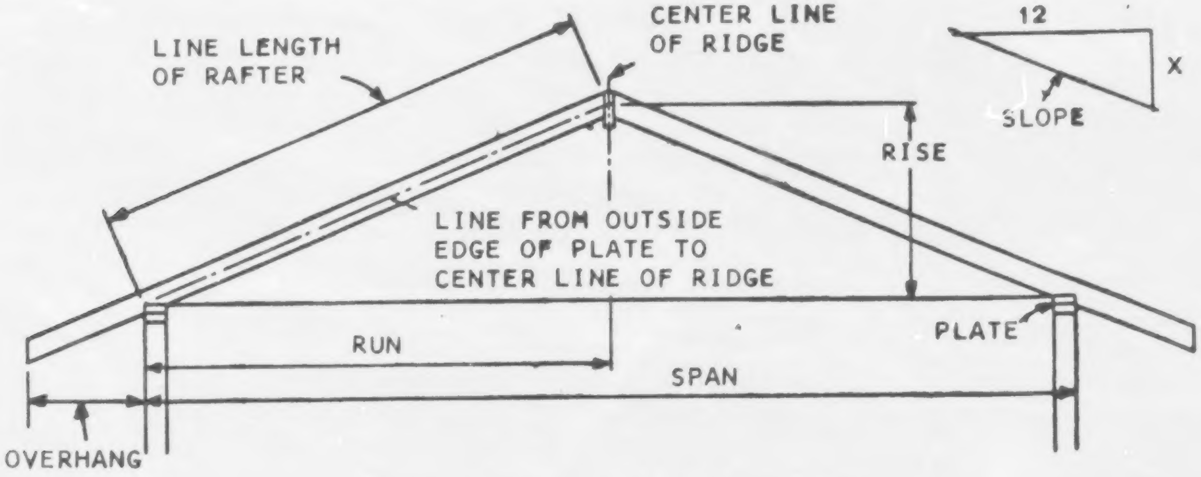
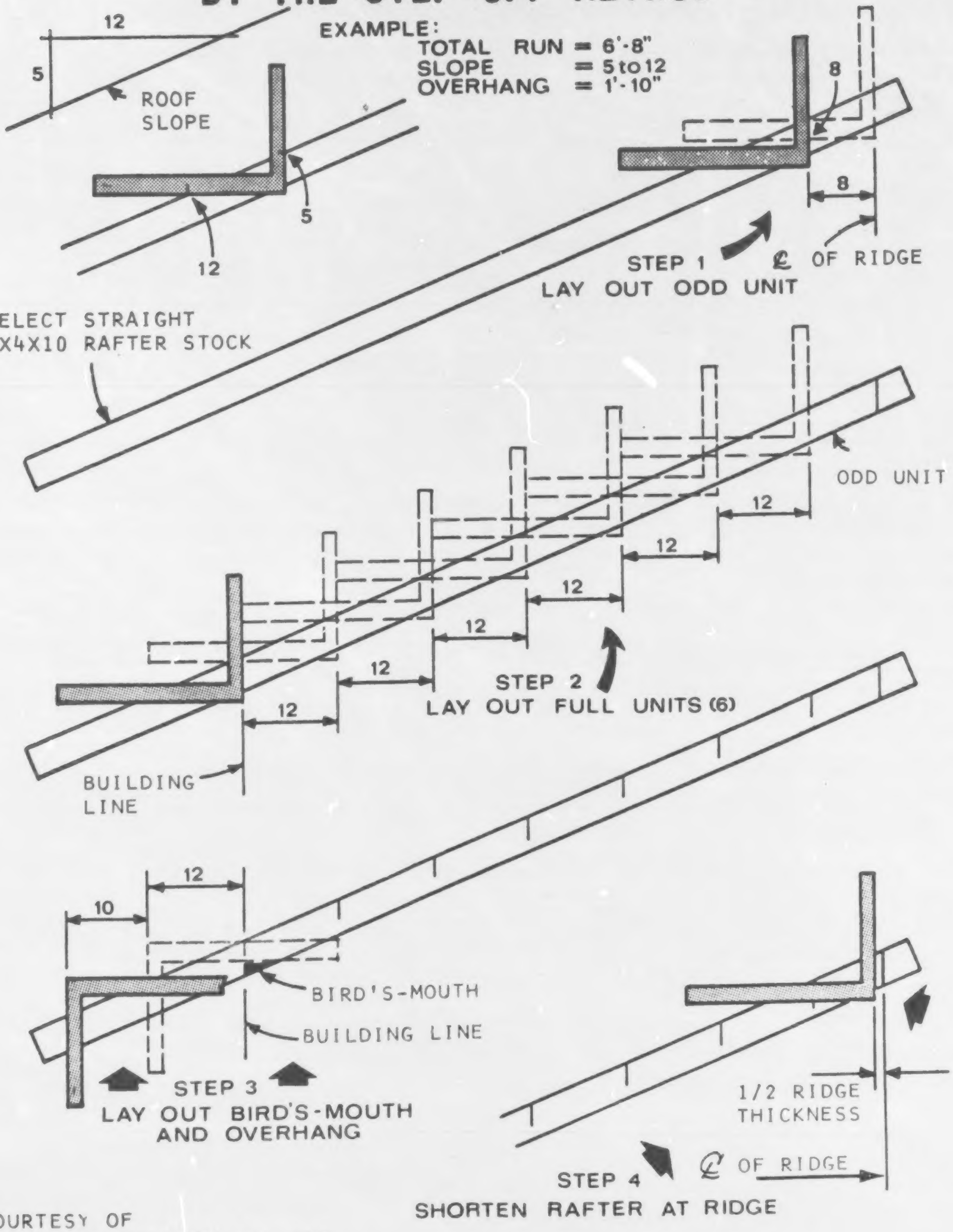


BASIC TERMS AND DIMENSIONS USED IN RAFTER LAYOUT

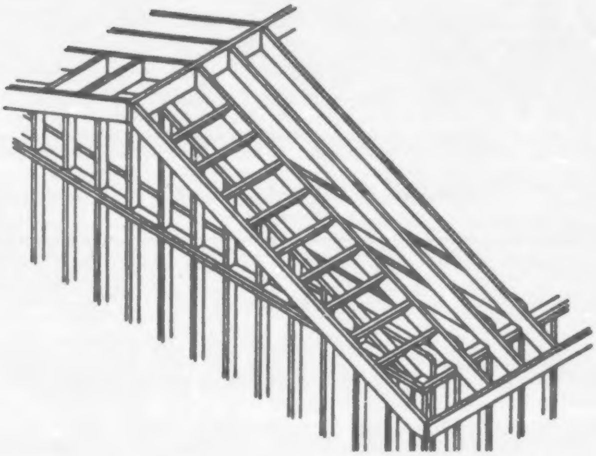
COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

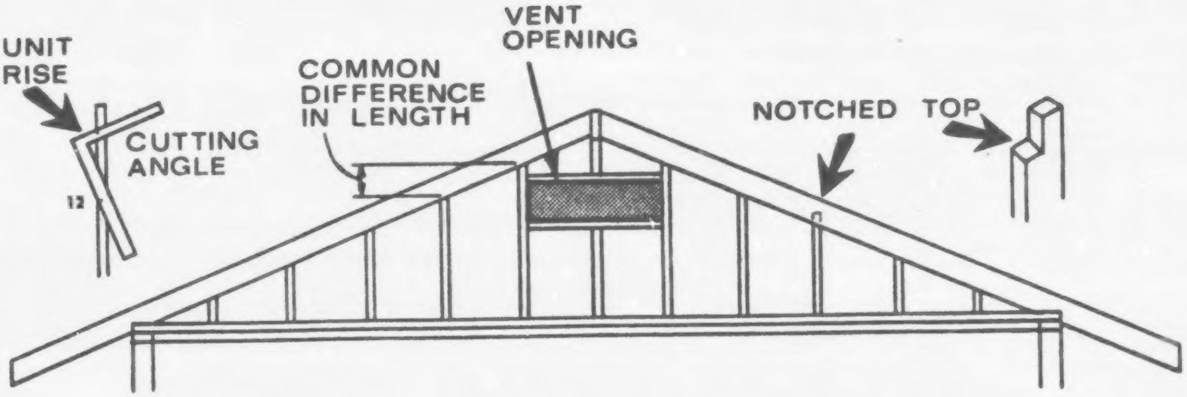
# LAYING OUT A COMMON RAFTER BY THE STEP-OFF METHOD



COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY

# FRAMING THE STUDS FOR A GABLE END

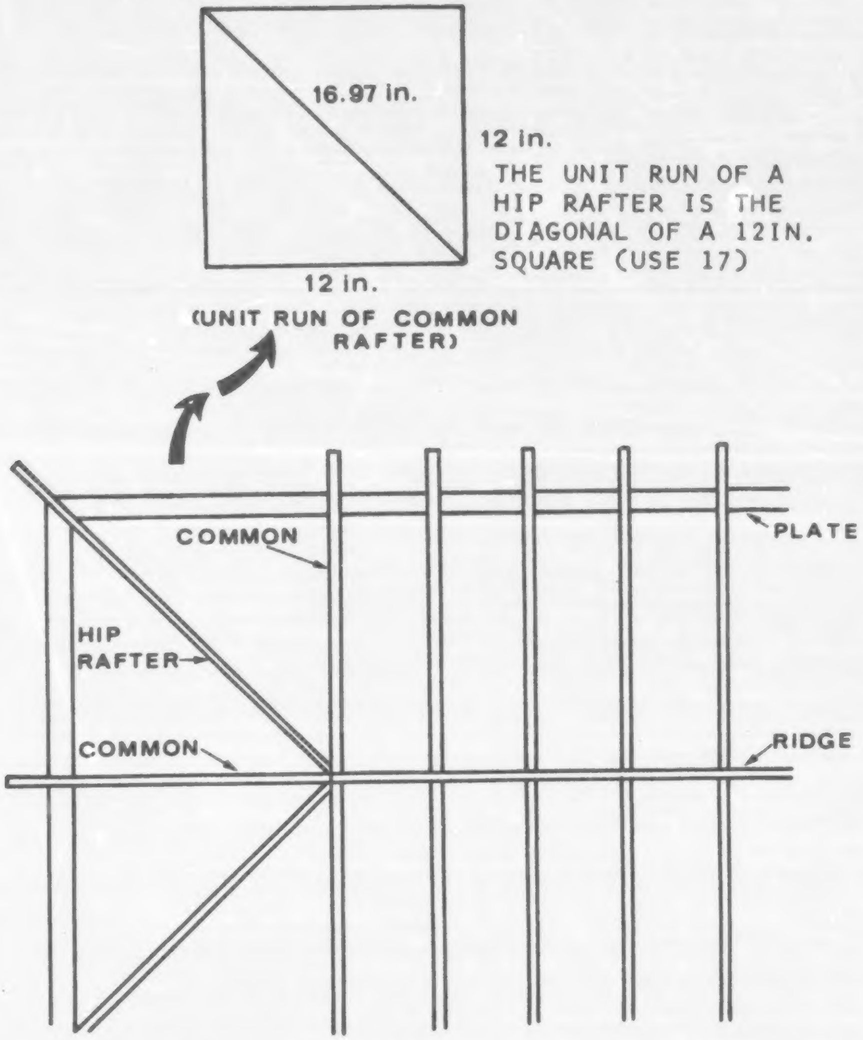




IML-UMC

COURTESY OF
GOODHEART-WILLCOX CO., INC.
MODERN CARPENTRY

# HIP RAFTERS

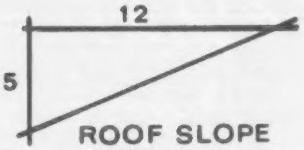


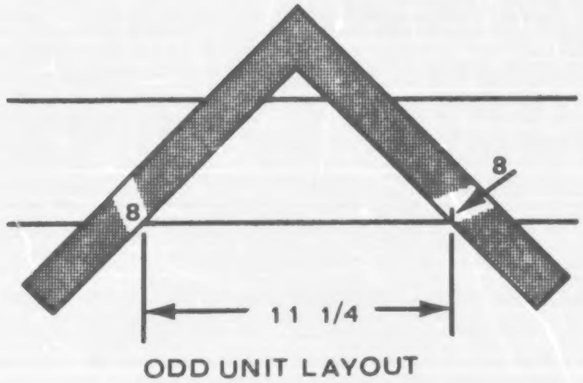
THE UNIT RUN OF A HIP RAFTER IS THE DIAGONAL OF A 12IN. SQUARE (USE 17)

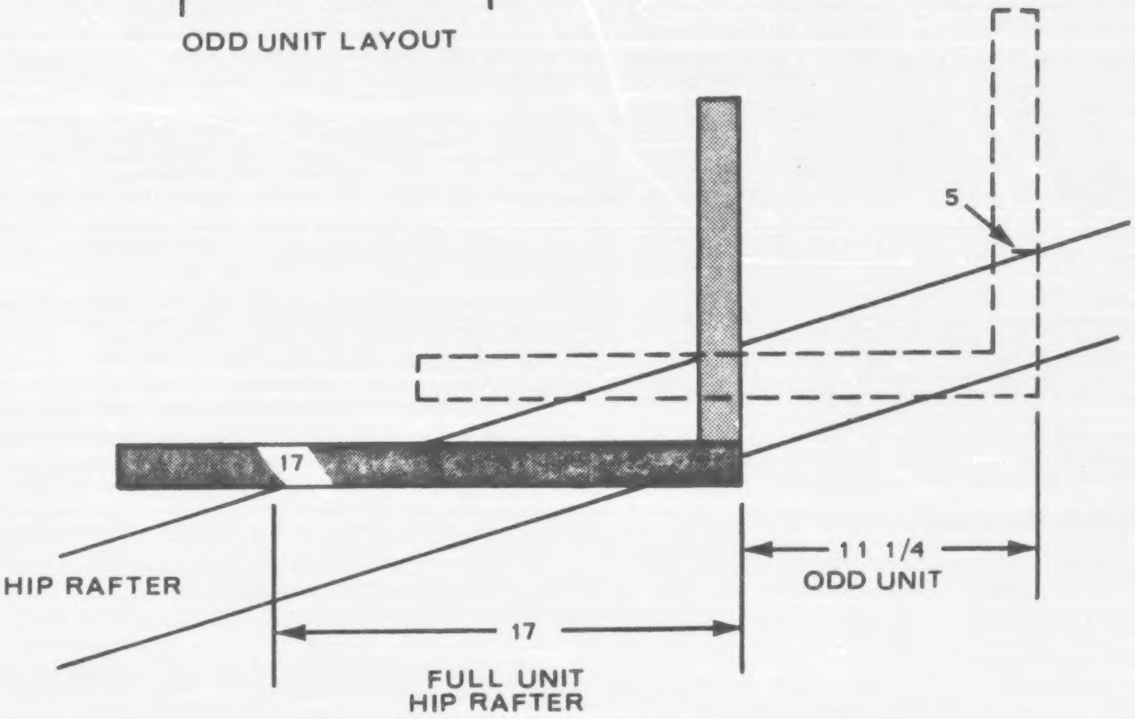
THE HIP RAFTER IS A DIAGONAL OF A SQUARE FORMED BY THE WALLS AND COMMON RAFTERS.

COURTESY OF GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY WILLIS WAGNER IML UMC

# LAYOUT OF A HIP RAFTER



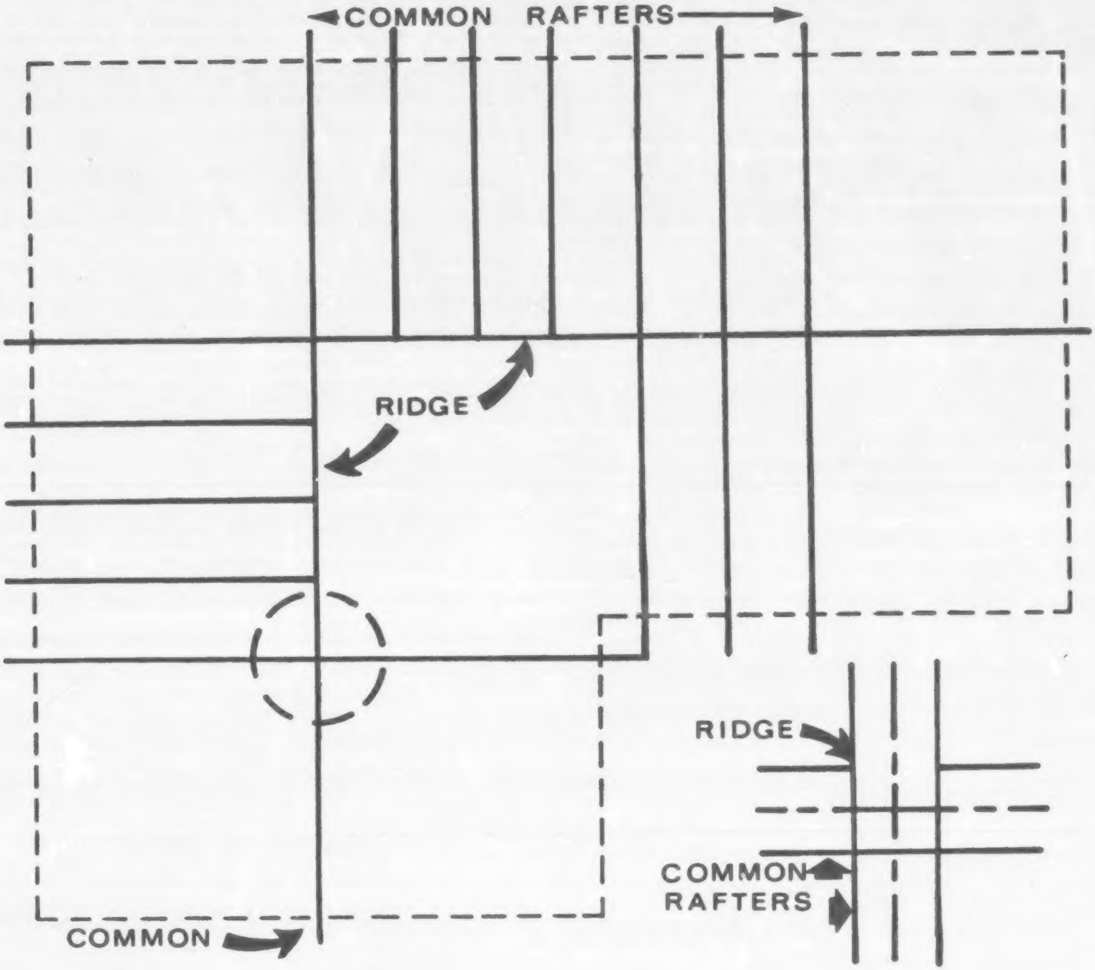




STARTING THE LAYOUT OF A HIP RAFTER. SLOPE AND ODD UNIT SIZE ARE THE SAME AS USED IN THE EXAMPLE FOR THE COMMON RAFTER LAYOUT.

COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

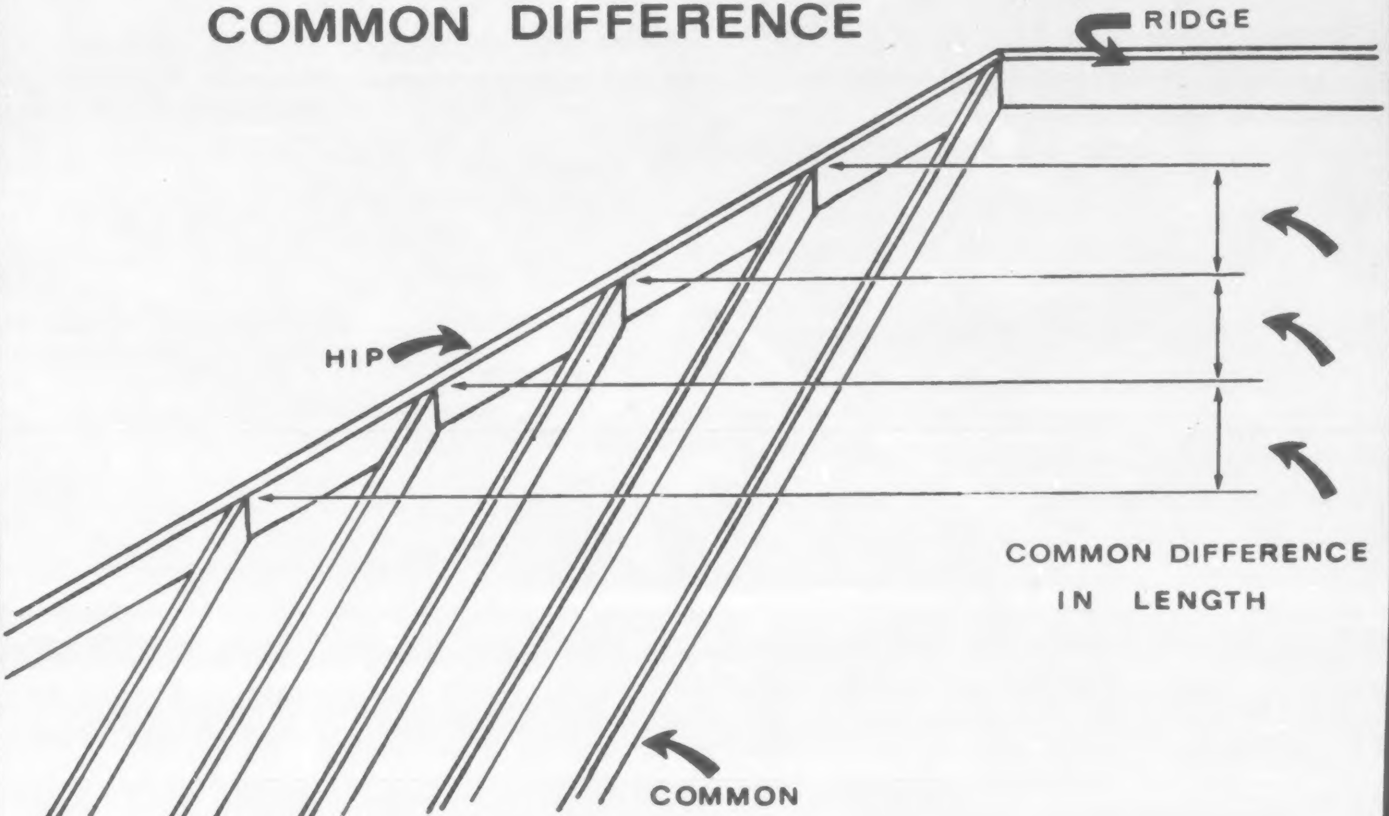
# FRAMING A HIP OR INTERSECTING ROOF



COURTESY OF: GOODHEART-WILLCOX CO. MODERN CARPENTRY BY WILLIS H. WAGNER IML-UMC

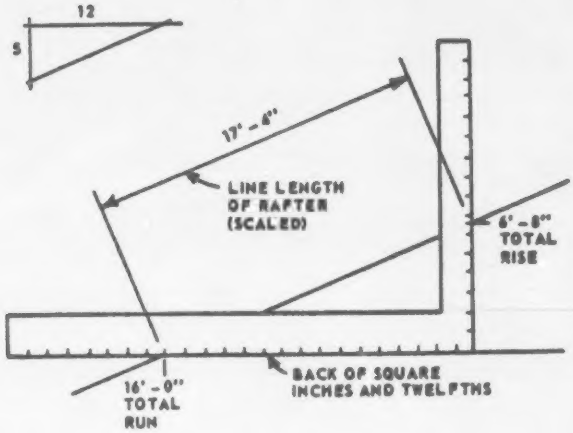
# HIP JACK RAFTERS

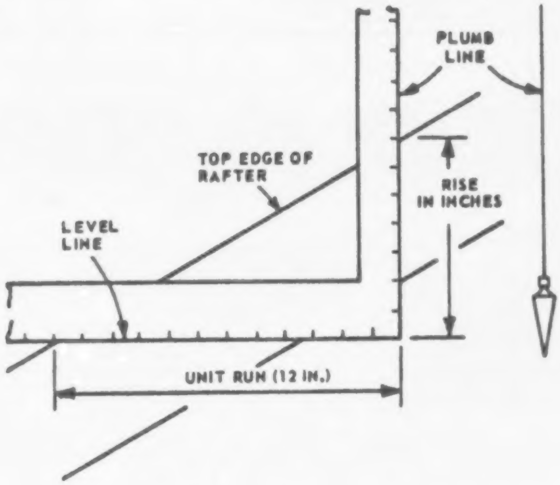
## COMMON DIFFERENCE



COURTESY OF GOODHEART-WILLCOX CO. MODERN CARPENTRY BY WILLIS H. WAGNER IML-UMC

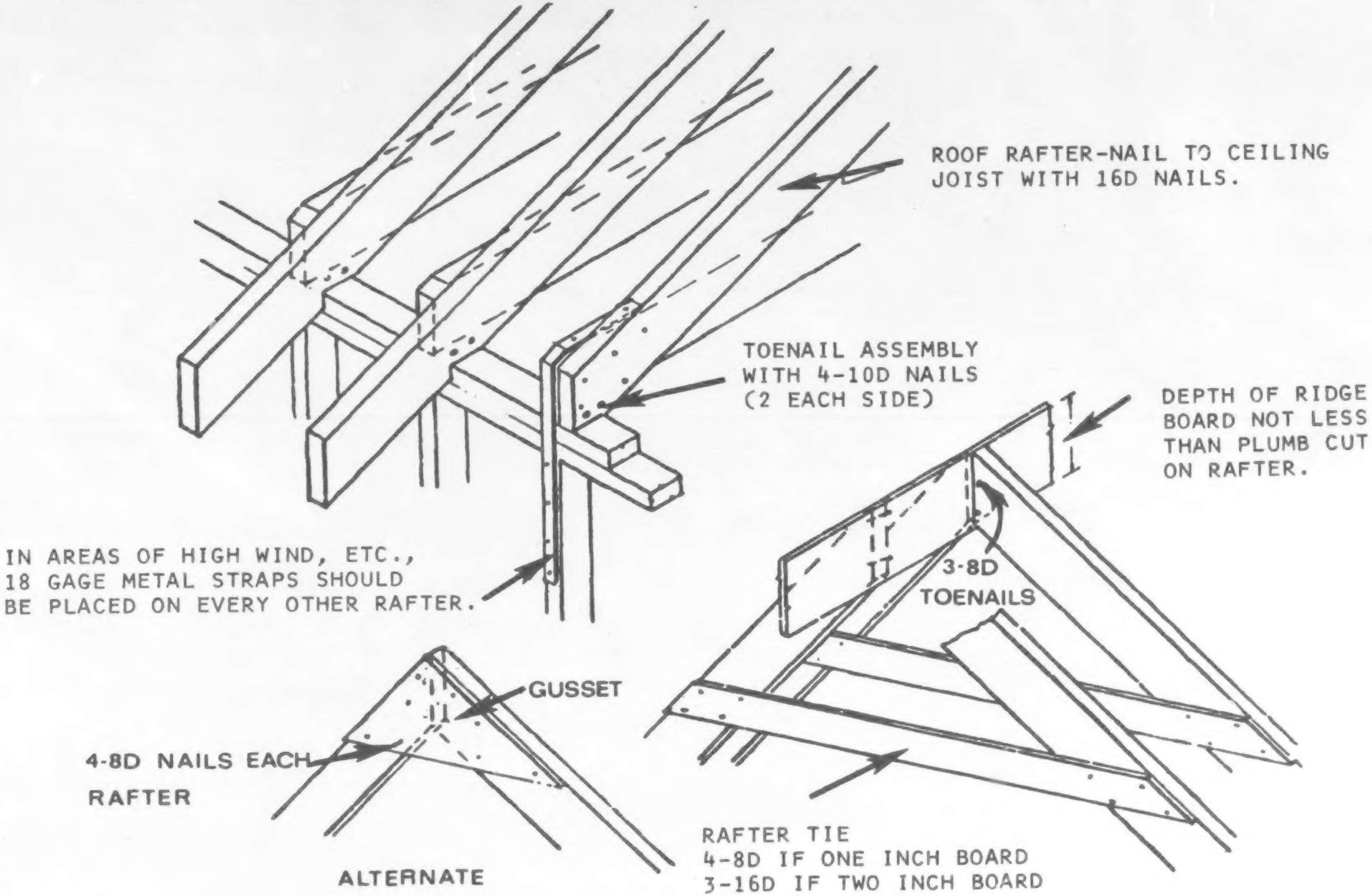
# ESTABLISHING RAFTER LENGTHS IN UNIT MEASUREMENT



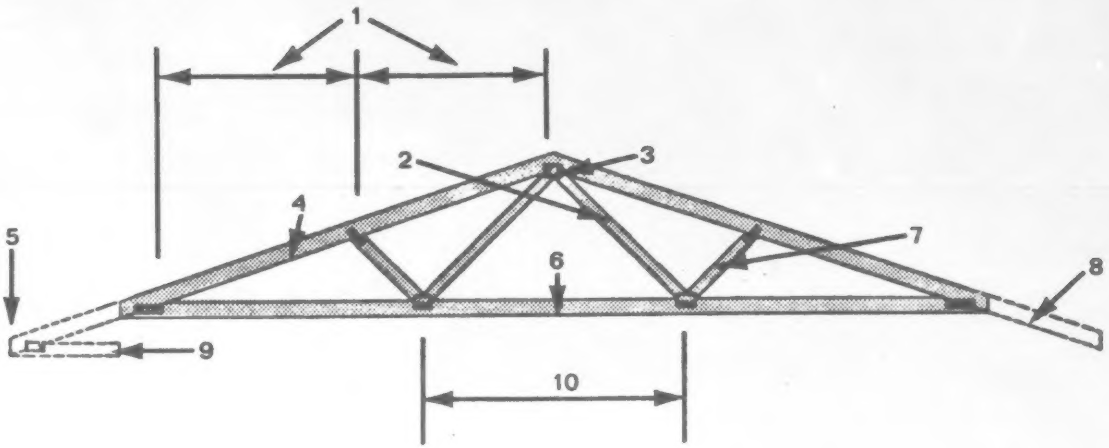


COURTESY OF
GOODHEART-WILLCOX CO. INC.
MODERN CARPENTRY
IML-UMC

# SECURING ROOF RAFTERS TO RIDGE AND PLATE


ROOF RAFTER-NAIL TO CEILING JOIST WITH 16D NAILS.
TOENAIL ASSEMBLY WITH 4-10D NAILS (2 EACH SIDE)
DEPTH OF RIDGE BOARD NOT LESS THAN PLUMB CUT ON RAFTER.
IN AREAS OF HIGH WIND, ETC., 18 GAGE METAL STRAPS SHOULD BE PLACED ON EVERY OTHER RAFTER.
3-8D TOENAILS
GUSSET
4-8D NAILS EACH RAFTER
ALTERNATE
RAFTER TIE
4-8D IF ONE INCH BOARD
3-16D IF TWO INCH BOARD

# STANDARD W OR FINK TRUSS

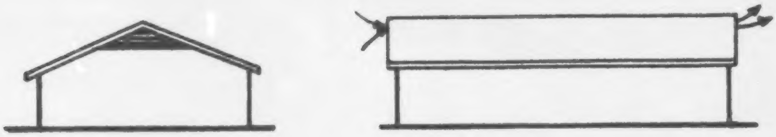


1. 1/4 SPAN
2. TENSION WEB
3. GANG-NAIL PLATE-BOTH SIDES AT EACH JOINT
4. TOP CHORD
5. PLUMB CUT RAFTER END
6. BOTTOM CHORD
7. COMPRESSION WEB
8. TAIL OPTIONAL
9. TAIL WITH RETURN OPTIONAL
10. 1/3 SPAN

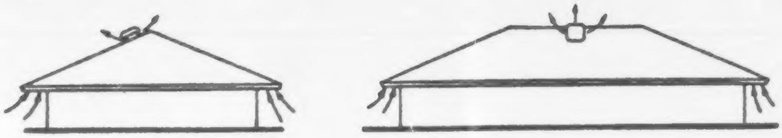
COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY BY
WILLIS H. WAGNER
IML-UMC

# METHODS OF VENTILATING ROOF SPACES AND AMOUNT OF VENTILATION REQUIRED

NET VENT AREA / CEILING AREA

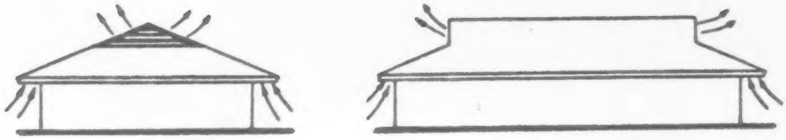


$\frac{1}{300}$



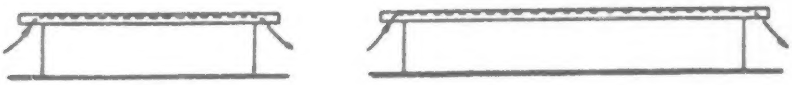
INLET $\frac{1}{900}$

OUTLET $\frac{1}{1600}$



INLET $\frac{1}{900}$

OUTLET $\frac{1}{900}$



$\frac{1}{250}$

COURTESY OF
NATIONAL FOREST PRODUCTS ASSOC.
WASHINGTON, D.C.

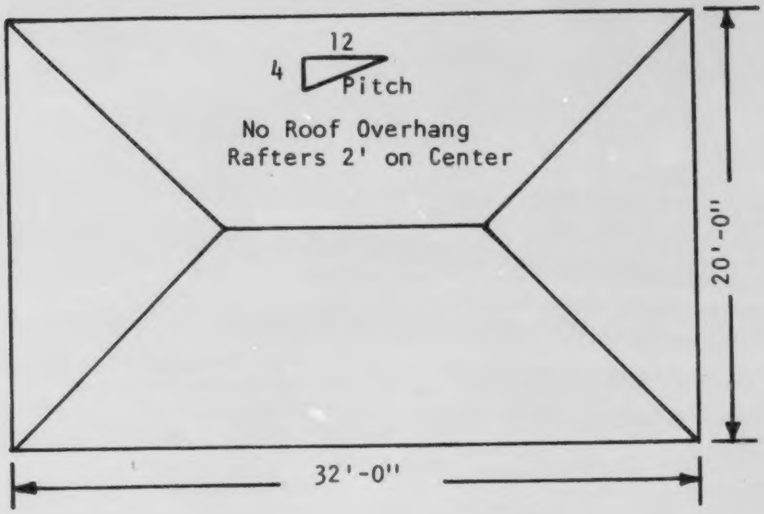
# ROOF FRAMING
## SECTION 5.3.0

## ASSIGNMENT SHEET #1 - COMPUTE RAFTER LENGTH

Using your framing square, calculate the length of the following roof members for the building illustrated below.

(NOTE: All material 2" x 6".)

1. Common-
2. Hip-
3. The third jack-
4. Ridge Board 2" x 6" x________________________________



# ROOF FRAMING
# SECTION 5.3.0

## ASSIGNMENT SHEET #2 - ESTIMATE ROOF FRAMING MATERIALS

Using your framing square, calculate the material needed to frame the roof illustrated below.

(NOTE: All material should be 2" x 6".)

1. Number and length of common rafters

2. Number and length of hip rafters

3. Number and lengths of each jack:

   #1

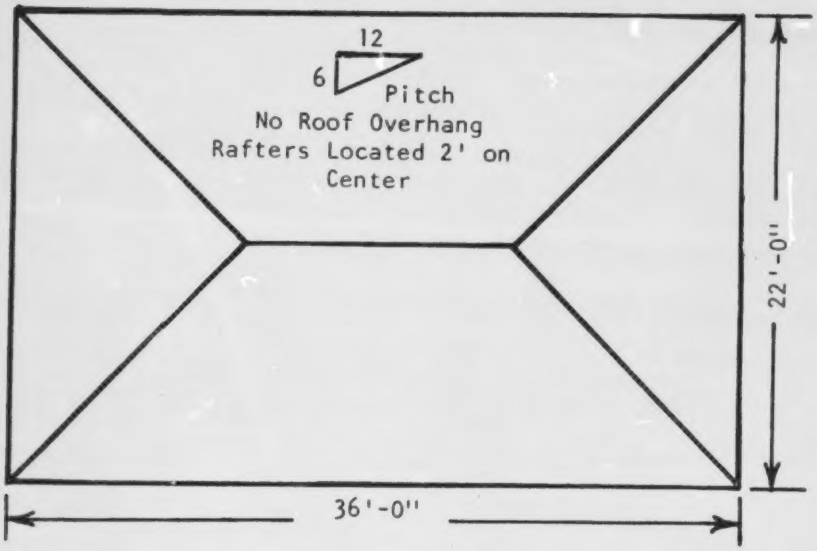
   #2

   #3

   #4

   #5

4. Length of ridge board



No Roof Overhang
Rafters Located 2' on Center

## ROOF FRAMING
## SECTION 5.3.0

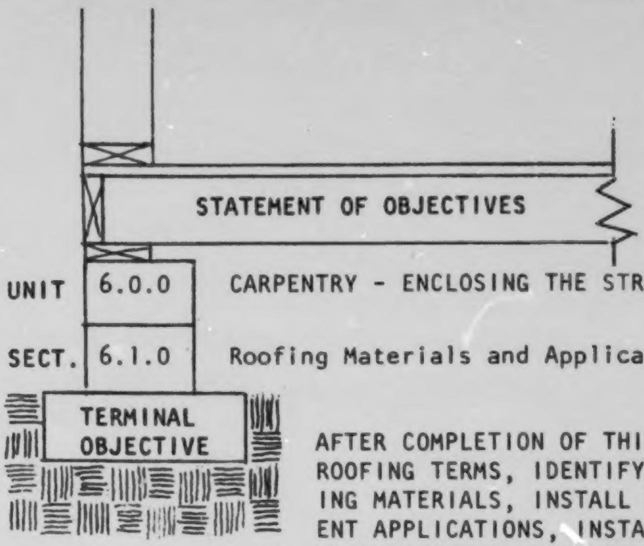
### ANSWERS TO ASSIGNMENTS #1 and #2

Assignment sheet #1

1. 10' 6 1/2"
2. 14' 6 3/8"
3. 14 5/8" or 1' 2 5/8"
4. 11' 10 1/2"

Assignment sheet #2

1. 15 - 2" x 6" x 12' 3 5/8"
2. 4 - 2" x 6" x 16' 6"
3. #1 8 - 2" x 6" x 10' 0 3/4"
   #2 8 - 2" x 6" x 7' 9 7/8"
   #3 8 - 2" x 6" x 5' 7"
   #4 8 - 2" x 6" x 3' 4 1/8"
   #5 8 - 2" x 6" x 1' 1 1/4"
4. 1 - 2" x 6" x 14' 1 1/2"



**STATEMENT OF OBJECTIVES**

**UNIT** 6.0.0 CARPENTRY - ENCLOSING THE STRUCTURE

**SECT.** 6.1.0 Roofing Materials and Application

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL DEFINE ROOFING TERMS, IDENTIFY VARIOUS SHEET AND NON-SHEET ROOFING MATERIALS, INSTALL FLASHING MATERIALS IN SEVERAL DIFFERENT APPLICATIONS, INSTALL ASPHALT SHINGLES TO SLOPING ROOFS USING COMMONLY RECOMMENDED STYLES AND PROCEDURES.

## SPECIFIC OBJECTIVES

After completion of this section the learner will:

6.1.1 In writing define the roofing terms: square, coverage, exposure, head lap, side lap, and shingle butt.

6.1.2 List four (4) of non-sheet materials generally applied to sloping roofs in residential structures.

6.1.3 Write four (4) kinds of sheet materials that are available for roofing residential structures.

6.1.4 Install galvanized drip edge to eaves and rakes of a roof.

6.1.5 Apply asphalt-saturated felt (15 lb. roofers felt) to roof deck as specified by the Asphalt Roofing Manufactures Association.

6.1.6 Install open type valley flashings to valley intersections of roofs prior to asphalt shingle installation.

6.1.7 Install flashings to woven and closed-cut valley intersections of roofs prior to asphalt shingle installation.

6.1.8 Install metal flashing shingles between sloping roof and vertical wall as specified by the Asphalt Roofing Manufactures Association.

6.1.9 Install roof flashings around chimneys, heater and ventilation vents, and plumbing vents (stacks) as specified by the Asphalt Roofing Manufactures Association.

6.1.10 Install starter strip beginning at the roof eave.

NOTE: STRIP SHINGLES MAY BE USED AS A STARTER STRIP BY INSTALLING THEM IN AN INVERTED POSITION.

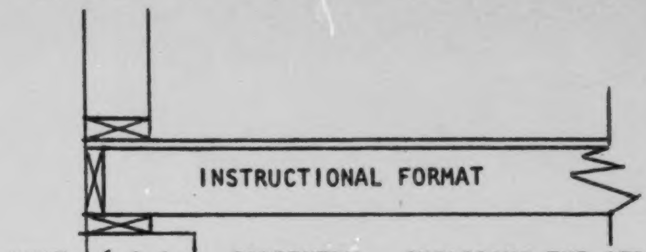
6.1.11 Install three tab square butt asphalt shingles with cutouts centered over the tabs in the course directly below.

NOTE: ALTERNATE PATTERNS MAY BE DEVELOPED DEPENDING UPON THE TYPE OF SHINGLE.

6.1.12 Install hip and ridge asphalt shingles to complete the coverage at roof intersections over ridge and hip rafters.

NOTE: RIDGE SHINGLES MAY BE MADE BY CUTTING STRIP SHINGLES INTO THREE EQUAL LENGTHS OF 12 INCHES.

6.1.13 Install ridge attic ventilator in place of ridge shingles when specified on the architectural drawings.



## INSTRUCTIONAL FORMAT

UNIT 6.0.0 CARPENTRY - ENCLOSING THE STRUCTURE

SECT. 6.1.0 Roofing Material and Application

## INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of roofing manufactures, local roofing contractors and trade associations or labor organizations who can provide supplemental information about roofing materials and their application.

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Roof Slope and Material Range
  - 2. TM 2 - Flashing At Various Points On Roof
  - 3. TM 3 - Valley Flashings
  - 4. TM 4 - Valley Flashings (con't)
  - 5. TM 5 - Flashing At A Wall
  - 6. TM 6 - Asphalt Strip Shingle Layout Patterns
  - 7. TM 7 - Low Slope Roof Applications
  - 8. TM 8 - Hip and Ridge Shingle Application
  - 9. TM 9 - Gutter and Downspout Installation
- D. Assignment sheet # 1 - Material Estimating (Roofing Materials)
- E. Answers to assignment sheet #1

IV. References:

- A. Cooper, George H. and Stanley Badzinski, Jr. Building Construction Estimating. St. Louis, Missouri: McGraw Hill, 1971.
- B. Durbahn, Walter E. and Robert E. Putnam. Fundamentals of Carpentry Tools, Materials and Practices. 5th. ed., Chicago, Illinois: American Technical Society, 1977.
- C. Durbahn, Walter E. and Elmer E. Sundberg. Fundamentals of Carpentry Practical Construction. 5th. ed., Chicago, Illinois: American Technical Society, 1977.
- D. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.
- E. Putnam, Robert E. and G. E. Carlson. Architectural and Building Trades Dictionary. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

F. Smith, Ronald C. *Principles and Practices of Light Construction*. Englewood Cliffs, New Jersey: Printice Hall Inc. 1970.

G. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976,

# ROOFING MATERIALS AND APPLICATION
## SECTION 6.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Roofing terms
   - A. Square
   - B. Coverage
   - C. Exposure
   - D. Head lap
   - E. Side lap
   - F. Shingle butt
   - G. Top lap
   - H. Slope
   - I. Pitch

II. Types of roof coverings
   - A. Non-sheet materials
     - 1. Wood
     - 2. Asphalt
     - 3. Asbestos
     - 4. Tile
     - 5. Slate
   - B. Sheet materials
     - 1. Roll roofing
     - 2. Galvanized iron
     - 3. Aluminum
     - 4. Copper
     - 5. Tin
     - 6. Built-up roof

III. Roofing accessories

- A. Dripedge
    - 1. Eave installation
    - 2. Rake installation
- B. Underlayment
    - 1. Protection purposes
        - a. Pre-roofing
        - b. Post roofing
        - c. Incompatibility characteristics
    - 2. Material composition
    - 3. Application specifications
        - a. Weight
        - b. Toplap
        - c. Sidelap
        - d. Hip and ridge laps
        - e. Fasteners
- C. Flashings
    - 1. Purpose
    - 2. Materials
        - a. Metals
            - 1. Galvanized steel (26 gauge)
            - 2. Aluminum (.019 thick)
            - 3. Copper (16oz.)
    - 3. Application locations
        - a. Valley intersections

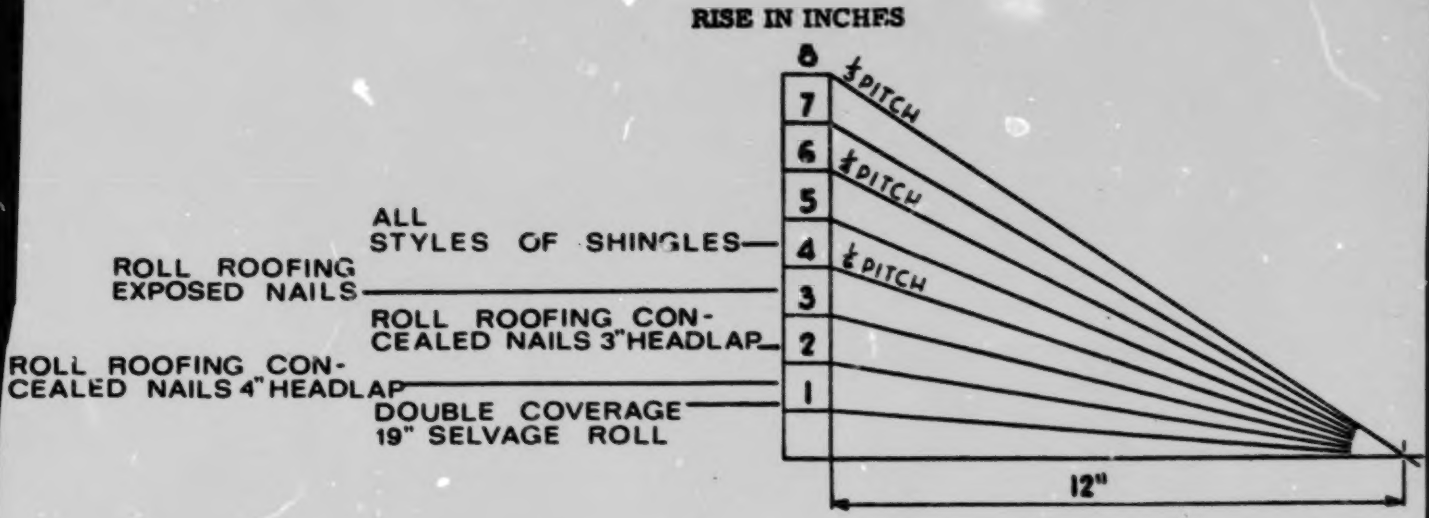
                1. Open valley installation specifications
                2. Closed valley installation specifications
            b. Soil stacks
            c. Chimney
            d. Wall intersections
    D. Asphalt roofing nails
        1. Types
            a. Smooth
            b. Annular threaded
            c. Screw threaded
        2. Manufacturing material
        3. Sizes
            a. New construction
            b. Over asphalt roofing

IV. Asphalt strip shingle installation procedures
    A. Starting position
    B. Alignment
    C. Fastening (nailing locations)
    D. Starter strip
    E. Laying patterns
    F. First and succeeding courses
    G. Hips and ridges

V. Low-slope asphalt shingle installation procedures
    A. Special precautions
        1. Double underlayment
        2. Cemented eave flashing
        3. Cement tabs

VI. Attic ridge ventilator

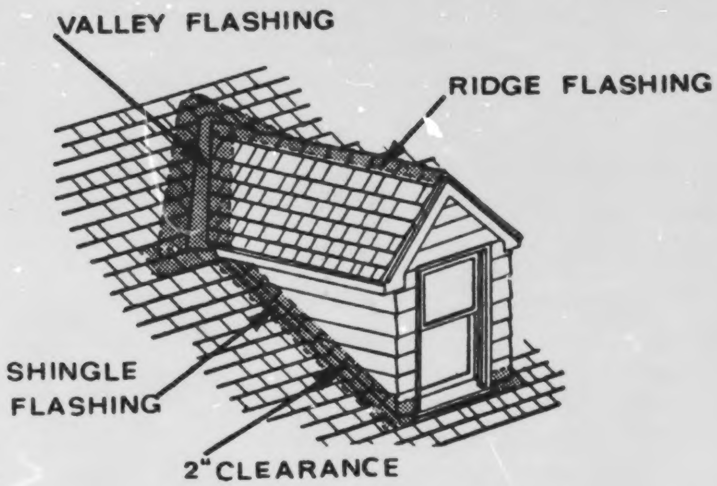
# ROOF SLOPE & MATERIAL RANGE


RISE IN INCHES
8
7
6
5
4
3
2
1
1/3 PITCH
1/4 PITCH
1/6 PITCH
ALL STYLES OF SHINGLES
ROLL ROOFING EXPOSED NAILS
ROLL ROOFING CONCEALED NAILS 3" HEADLAP
ROLL ROOFING CONCEALED NAILS 4" HEADLAP
DOUBLE COVERAGE 19" SELVAGE ROLL
12"

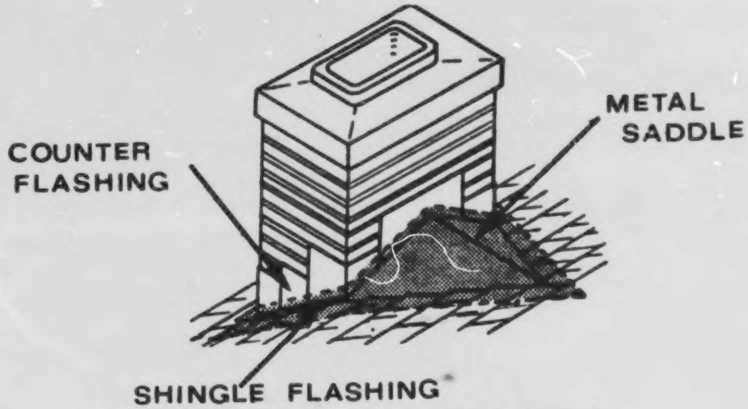
SLOPE OF ROOF LIMITS THE RANGE OF MATERIALS THAT CAN BE USED. THE PORTION OF THE INDIVIDUAL UNITS (SHINGLES) EXPOSED TO THE WEATHER MUST BE REDUCED ON LOW-SLOPED ROOFS.

COURTESY OF
GOODHEART-WILLCOX CO.
MODERN CARPENTRY
IML-UMC

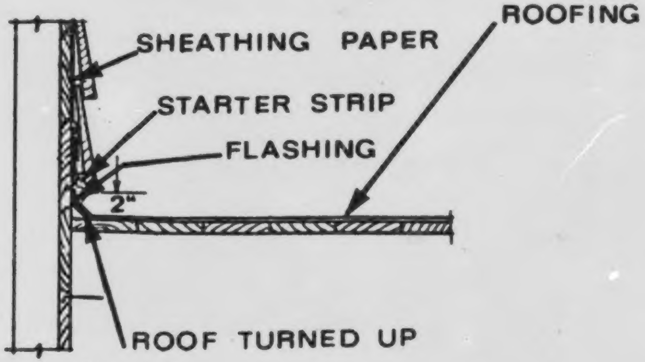
# FLASHING AT VARIOUS POINTS ON ROOF



VALLEY & DORMER



AROUND CHIMNEY



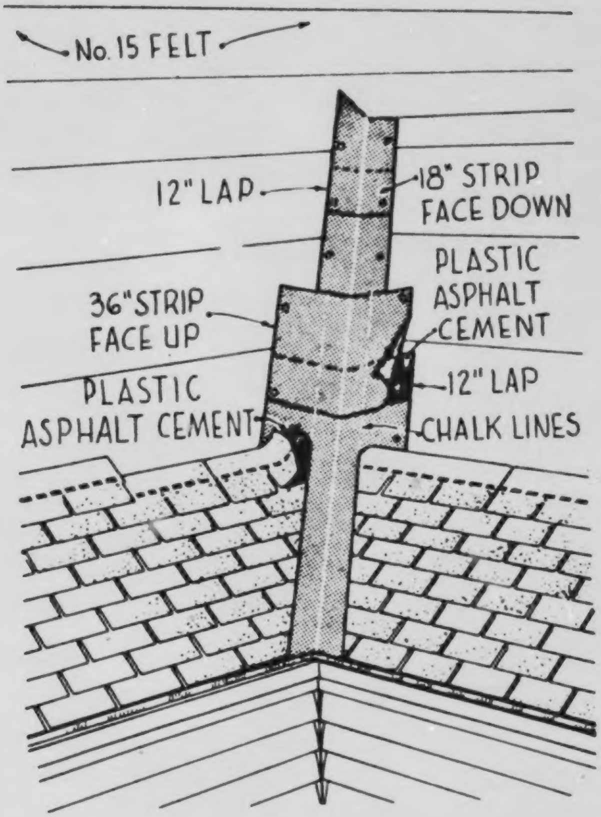
WOOD SIDING & ROOF

6.1.0 - TM 2

COURTESY OF
NATIONAL FOREST PRODUCTS ASSOC.
WASHINGTON, D.C.

IML-UMC

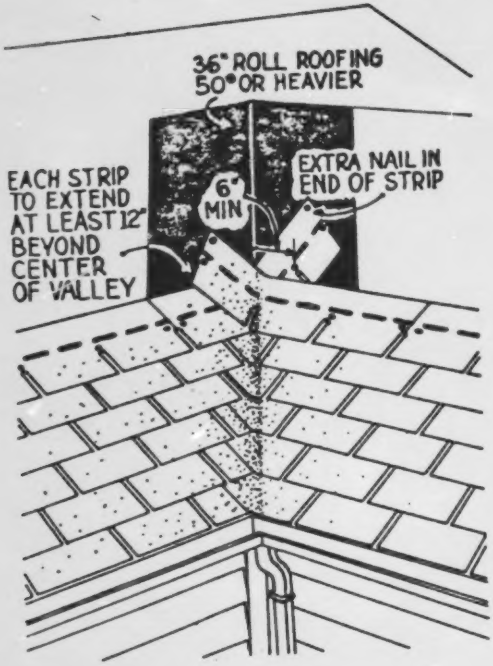
# VALLEY FLASHING



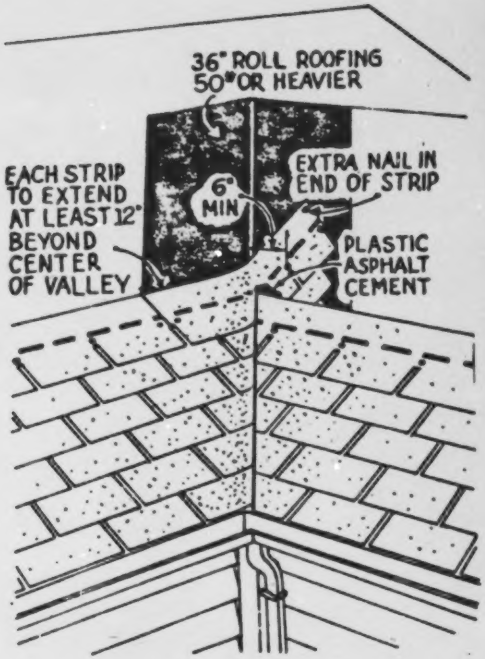
OPEN

COURTESY OF
ASPHALT ROOFING MANUFACTURES ASSOCIATION

# VALLEY FLASHING



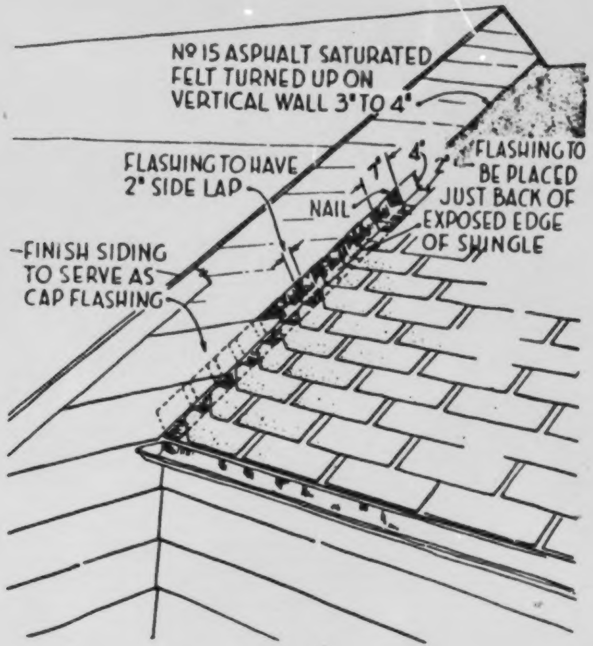
WOVEN



CLOSED CUT

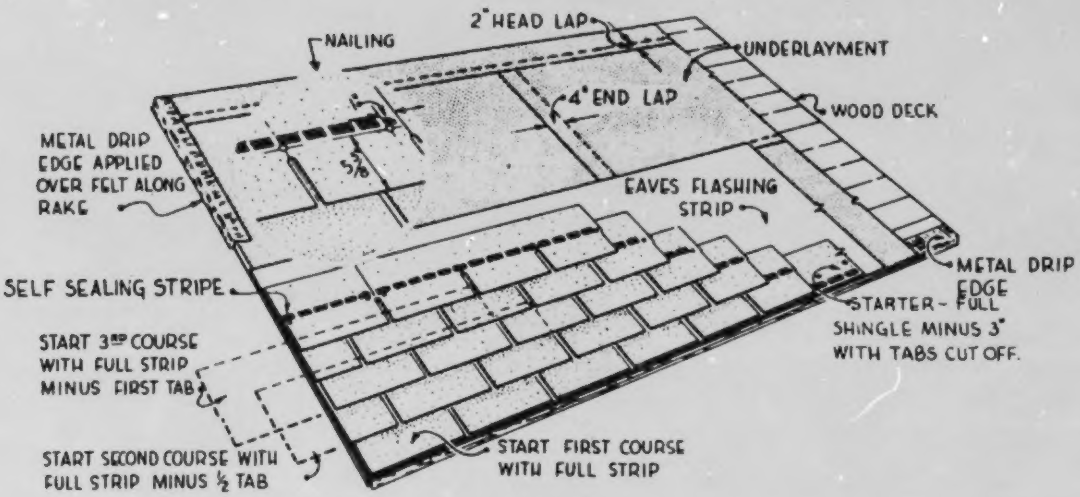
COURTESY OF
ASPHALT ROOFING MANUFACTURERS ASSOCIATION

# FLASHING AT A WALL

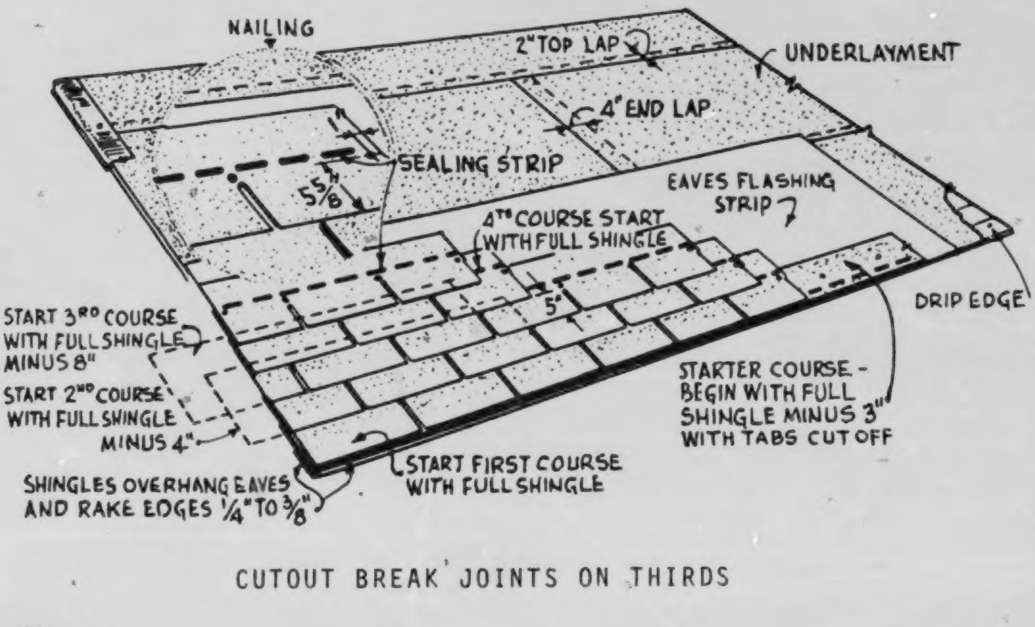

Nº 15 ASPHALT SATURATED FELT TURNED UP ON VERTICAL WALL 3" TO 4"
FLASHING TO HAVE 2" SIDE LAP
7"
4"
NAIL
FLASHING TO BE PLACED JUST BACK OF EXPOSED EDGE OF SHINGLE
FINISH SIDING TO SERVE AS CAP FLASHING

COURTESY OF
ASPHALT ROOFING MANUFACTURES ASSOCIATION

# ASPALT STRIP SHINGLES LAYING PATTERNS


NAILING
2" HEAD LAP
UNDERLAYMENT
4" END LAP
WOOD DECK
METAL DRIP EDGE APPLIED OVER FELT ALONG RAKE
5 5/8
EAVES FLASHING STRIP
SELF SEALING STRIPE
METAL DRIP EDGE
STARTER - FULL SHINGLE MINUS 3" WITH TABS CUT OFF.
START 3RD COURSE WITH FULL STRIP MINUS FIRST TAB
START SECOND COURSE WITH FULL STRIP MINUS ½ TAB
START FIRST COURSE WITH FULL STRIP

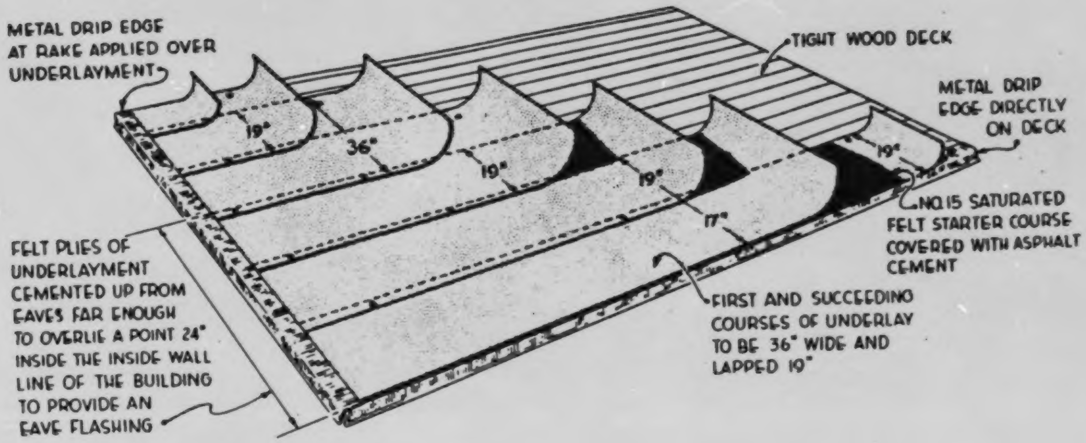
CUTOUT BREAK JOINT ON HALVES


NAILING
2" TOP LAP
UNDERLAYMENT
4" END LAP
SEALING STRIP
5 5/8"
EAVES FLASHING STRIP
4TH COURSE START WITH FULL SHINGLE
5"
DRIP EDGE
START 3RD COURSE WITH FULL SHINGLE MINUS 8"
START 2ND COURSE WITH FULL SHINGLE MINUS 4"
STARTER COURSE - BEGIN WITH FULL SHINGLE MINUS 3" WITH TABS CUT OFF
START FIRST COURSE WITH FULL SHINGLE
SHINGLES OVERHANG EAVES AND RAKE EDGES ¼" TO ⅜"

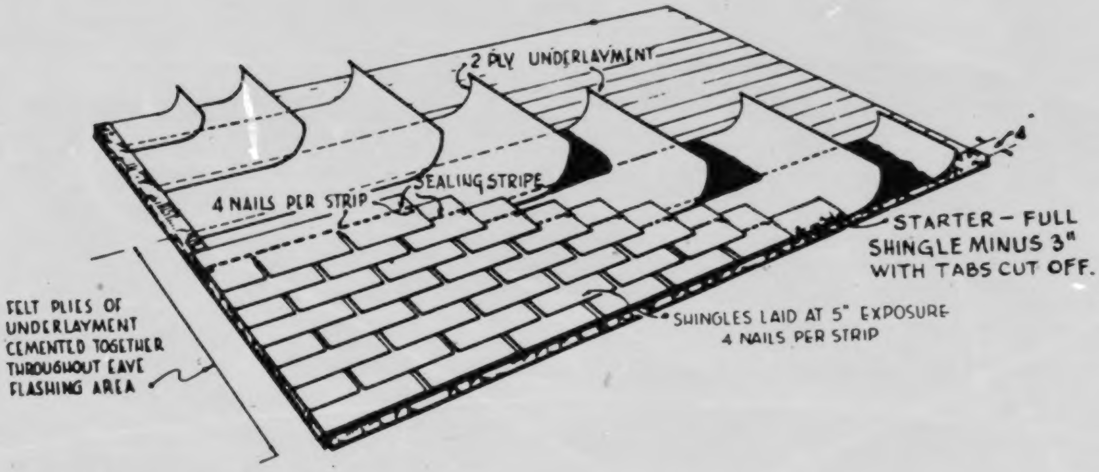
CUTOUT BREAK JOINTS ON THIRDS

COURTESY OF
ASPHALT ROOFING MANUFACTURES
ASSOCIATION

# LOW SLOPE ROOF APPLICATION


METAL DRIP EDGE AT RAKE APPLIED OVER UNDERLAYMENT
TIGHT WOOD DECK
METAL DRIP EDGE DIRECTLY ON DECK
19"
36"
19"
19"
19"
17"
NO.15 SATURATED FELT STARTER COURSE COVERED WITH ASPHALT CEMENT
FELT PLIES OF UNDERLAYMENT CEMENTED UP FROM EAVES FAR ENOUGH TO OVERLIE A POINT 24" INSIDE THE INSIDE WALL LINE OF THE BUILDING TO PROVIDE AN EAVE FLASHING
FIRST AND SUCCEEDING COURSES OF UNDERLAY TO BE 36" WIDE AND LAPPED 19"

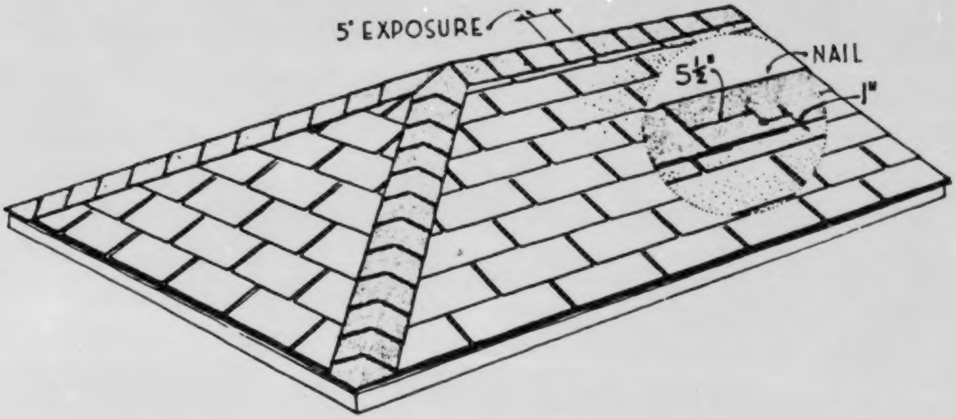
SATURATED FELT UNDERLAY


2 PLY UNDERLAYMENT
4 NAILS PER STRIP
SEALING STRIPE
4"
STARTER – FULL SHINGLE MINUS 3" WITH TABS CUT OFF.
FELT PLIES OF UNDERLAYMENT CEMENTED TOGETHER THROUGHOUT EAVE FLASHING AREA
SHINGLES LAID AT 5" EXPOSURE 4 NAILS PER STRIP

APPLICATION OF SHINGLES OVER DOUBLE UNDERLAY

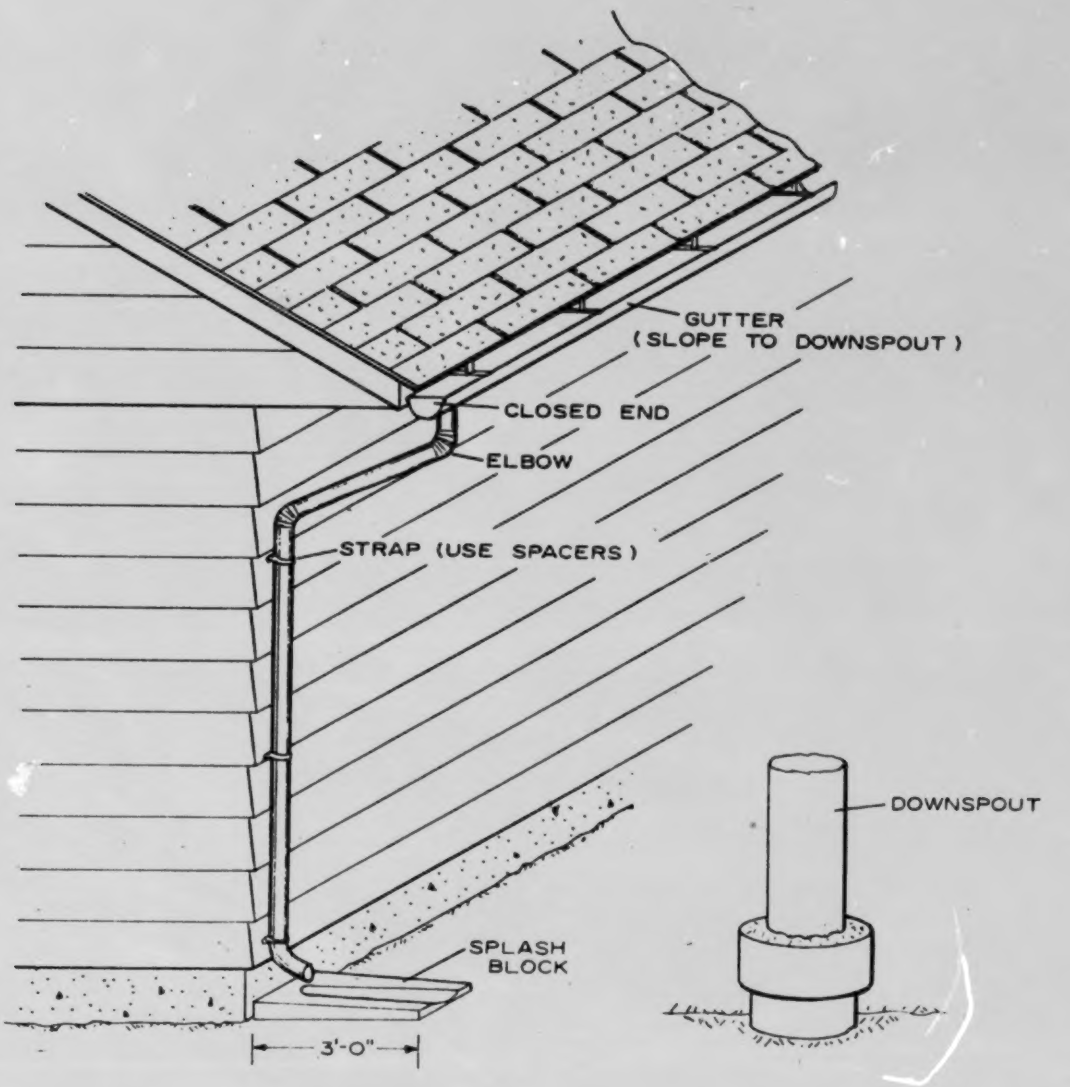
COURTESY OF
ASPHALT ROOFING MANUFACTURES
ASSOCIATION

# HIP AND RIDGE SHINGLE APPLICATION



COURTESY OF
ASPHALT ROOFING MANUFACTURES ASSOCIATION

# GUTTER AND DOWNSPOUT INSTALLATION



# ROOFING MATERIALS AND APPLICATION
## SECTION 6.1.C

## ASSIGNMENT SHEET #1 - MATERIAL ESTIMATING

Calculate the following roofing materials needed from the roof plan depicted below.

________1. Lineal feet of drip edge (rake and eave)

________2. Lineal feet of ridge vent

________3. Number of ridge vent ends

________4. Square feet of underlayment + 5% for lapping

________5. Squares of underlayment

________6. Square feet of shingle material + 5% for cutting

________7. Squares of shingle material excluding ridge shingles

________8. Lineal feet of open valley flashing (18" mineral surfaced roll roofing) + 10% for cutting and overlap

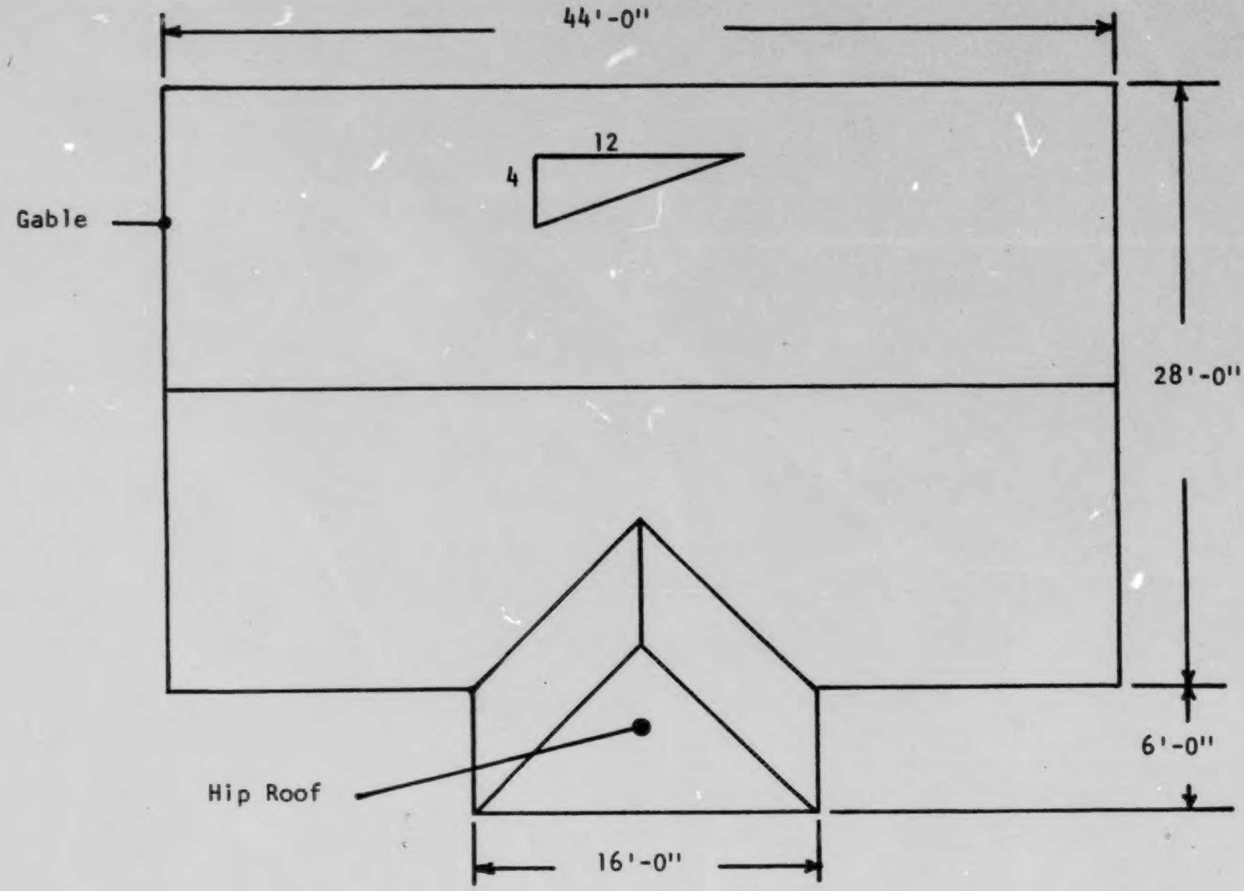
________9. Lineal feet of open valley flashing (36" mineral surfaced roll roofing) + 10% for cutting and overlap

________10. Lineal feet of hip and ridge shingles

________11. Pounds of 1 1/4 inch roofing nails. (2 1/4 pounds per square are required for a 1 1/4 inch roofing nail)

________12. Number (thousands) of 3/8" wire staples. (figure 4000 staples for each roll of 15lb. saturated felt)

NOTE: One roll of 15lb. saturated building felt contains 432 square feet.



ROOF PLAN
(GABLE AND HIP)
4/12 Pitch

## ROOFING MATERIALS AND APPLICATION
## SECTION 6.1.0

### ANSWERS TO ASSIGNMENT #1

1. 159 lineal feet
2. 50 lineal feet
3. 4 ends
4. 1470
5. 15
6. 1470
7. 15
8. 26
9. 26
10. 73
11. 34
12. 16

## STATEMENT OF OBJECTIVES

UNIT 6.0.0 CARPENTRY - ENCLOSING THE STRUCTURE

SECT. 6.2.0 Exterior Finish Trim and Wall Coverings

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL DEFINE TERMS USED TO DESCRIBE THE MORE GENERALLY USED CORNICE PARTS, IDENTIFY MAJOR DOOR AND WINDOW SIZING SYSTEM, INSTALL EXTERIOR DOORS AND WINDOW UNITS, IDENTIFY AND INSTALL COMMON SIDING APPLICATIONS, RECOGNIZE COMMON BRICK BONDS AND PERFORM THE NECESSARY KNOWLEDGE AND SKILLS LEADING TO THE CONSTRUCTION OF AN EXTERIOR VENEER BRICK WALL SURFACE. ALSO THE LEARNER WILL CONTROL ROOF WATER RUNOFF BY INSTALLING GUTTERING.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

6.2.1 Sketch a section view of a typical cornice construction with the following parts and specifications: roof slope of 4/12; parts consisting of exterior wall stud, wall sheathing, ledger, roof sheathing, and ceiling joist. Label each part.

6.2.2 Name three cornice designs generally used in connection with the construction of wide roof overhangs. Compare three types of soffit (plancier) construction.

6.2.3 Layout, cut and install framing parts of ledger and lookouts in preparation for the construction of a horizontal box cornice.

NOTE: OMIT IF ARCHITECTURAL PLANS CALL FOR AN OPEN CORNICE.

6.2.4 Install horizontal covering to underside of cornice lookouts.

6.2.5 Construct the rake section at the end of the roof over the gable to match the cornice.

6.2.6 Install covering to the underside of the rake overhang.

6.2.7 Install frieze to intersection of exterior wall and soffit.

NOTE: THE FRIEZE IS SOMETIMES SUBSTITUTED ON CONTEMPORARY STRUCTURES BY THE USE OF A MOLDING PLACE AT THE INTERSECTION OF THE EXTERIOR SIDING AND THE SOFFIT.

6.2.8 Calculate the number and size of soffit and gable ventilators necessary to meet or exceed the attic ventilation needs as specified by HUD Minimum Property Standards for One and Two Family Dwellings and install.

NOTE: REMEMBER SOFFIT VENTILATION SERVES AS A PORTION OF THE TOTAL ATTIC VENTILATION SYSTEM.

6.2.9 Classify windows under three (3) basic headings and write the name and description of one window type for each classification.

6.2.10 List four(4) ways in which window sizes are generally placed in manufacturers catalogues.

6.2.11 Place windows in previously framed rough openings, wedge sill to correct height and to level position, plumb side jambs and nail through side and top casings into the building frame.

NOTE: INSTALL WINDOWS WITH SASHES IN CLOSED POSITION AND DIAGONAL BRACES OR SPACER STRIPS INTACT.

6.2.12 Specify the minimum height and width of exterior entrances and rear service doors as indicated in HUD Minimum Property Standards.

6.2.13 Compare the construction characteristics of three (3) commonly used exterior door units. (1) panel, (2) flush, (3) metal clad. List one advantage and disadvantage of each.

6.2.14 Place preconstructed exterior door units in framed openings, shim side jambs to plumb position and nail through side and top casings into the building frame.

6.2.15 Layout, cut and install garage door jambs and exterior casings.

6.2.16 Execute nine (9) major steps to complete a sectional roll up garage door installation.

> NOTE: MANUFACTURERS SUPPLY DETAILED DIRECTIONS AND PROCEDURES FOR THE INSTALLATION OF THEIR PARTICULAR PRODUCTS. FOLLOW THESE STEPS CAREFULLY.

6.2.17 Apply a primer coat of paint to all exterior trim and doors, where applicable, as soon as practical to provide protection from the elements.

> NOTE: MANY PRODUCTS PRIMED DURING THE MANUFACTURING PROCESS DO NOT NEED A PRIMER COAT APPLICATION.

6.2.18 Sketch the end view of five (5) types of horizontal siding and lable each.

6.2.19 Sketch the end view of four (4) methods of applying board and batten exterior wall coverings. Label each.

6.2.20 Name five (5) plywood siding styles available as exterior wall coverings and describe each by sketch.

6.2.21 List five (5) additional products generally used as exterior wall coverings.

6.2.22 Layout, cut and apply horizontal siding.

6.2.23 Layout, cut and apply vertical siding panels.

6.2.24 Sketch and label five (5) brick bonds commonly used.

6.2.25 Layout exterior wall in preparation for installation of brick by establishing head joint location and allowance for mortar joints by stringing out (placing) the first course of brick without mortar. Adjust for minimum cutting by varing width of head joints.

6.2.26 Layout vertical position of all brick courses and mortar joints on a story pole. Anticipate slight vertical adjustments in thickness of mortar joint to compensate for door and window sill placement.

6.2.27 Repeat task 3.1.15. Measure and mix mortar ingredients until the mortar is uniform, cohesive and of a consistency that makes it usable.

6.2.28 Add coloring to mortar as per specifications on container.

6.2.29 Load a masonry trowel and spread mortar on masonry units (brick) until the fundamental steps have been acquired. (See next task.)

6.2.30 Build a lead about six courses high at each corner to establish proper height and provide a place to attach the mason's line.

> NOTE: THE HEIGHT OF EACH COURSE IS DETERMINED BY A MASON'S RULE OR STORY POLE WITH HEIGHT MARKS ON IT.

6.2.31 Tool vertical and horizontal mortar joints when the mortar has become "thumb print hard" or when the mortar is compacted.

6.2.32 Layout and cut line brick to specified lengths within a tolerance of + 1/8 inch.

6.2.33 Lay stretcher bricks from both leads to the center using a taut line as a guide.

6.2.34 Place metal ties in mortar joints and affix to frame of the structure.

6.2.35 Layout, cut and install end caps and outlet tubes to metal guttering sections before installation to fascia.

6.2.36 Install guttering sections to fascia using hangers or spike and ferrule system of attachment.

> NOTE: NAIL SPIKE INTO END OF ROOF RAFTER IF FASCIA IS MADE OF 3/4 INCH THICK MATERIAL.

6.2.37 Layout and cut down spouts to length and trial fit to structure using appropriate elbows.

6.2.38 Fasten down spouts to structure with a minimum of two straps placed near the top and bottom portions of the downspout directly adjacent to the exterior wall of the structure.

> NOTE: AVOID EXTRA LONG LENGTHS OF GUTTERING (OVER 30 FEET) BECAUSE OF POSSIBLE RUPTURE FROM EXCESSIVE EXPANSION AND CONTRACTION OF METALS.

# INSTRUCTIONAL FORMAT

UNIT 6.0.0 CARPENTRY - ENCLSOING THE STRUCTURE

SECT. 6.2.0 Exterior Finish Trim and Wall Coverings

## INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

   A. Provide learner with statement of objectives sheet

   B. Discuss terminal and specific objectives

   C. Provide learner with instruction sheets for use with this section

   D. Explain evaluation procedures

II. Suggested instructional methods:

   A. Demonstration - to show manipulative operations at construction site

   B. Discussion - to encourage question and answer activities

   C. Team assignment - to enhance personal relationships in the work environment.

   D. Illustrated lecture - to introduce a lesson or focus attention

   E. Field trips - to illustrate construction techniques and application of materials

   F. Consultant - representatives of local residential construction firms, trade associations, labor organizations and building material manufacturers who may provide supplemental information about exterior finish trim and wall coverings.

III. Instructional materials included in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

1. TM 1 - Narrow Box Cornice
2. TM 2 - Wide Box Cornice (Without Lookouts)
3. TM 3 - Wide Box Cornice (Horizontal Lookouts)
4. TM 4 - Close Cornice
5. TM 5 - Window Types
6. TM 6 - Window Types
7. TM 7 - Types of Wood Siding
8. TM 8 - Vertical Board Siding
9. TM 9 - Basic Pattern Bonds
10. TM 10 - Patterns Suited to Roman or Norman Brick
11. TM 11 - Using a Mason's Trowel
12. TM 12 - Using a Mason's Trowel
13. TM 13 - Outside Corner Lead
14. TM 14 - Mason Line Installations
15. TM 15 - Tooled Mortar Joints

D. Assignment sheets:

1. Assignment sheet #1 - Material Estimating
2. Assignment sheet #2 - Masonry Terms and Definitions

E. Answers to assignments #1 and #2

## IV. References:

A. Cooper, George H. and Stanley Badzinski, Jr. *Building Construction Estimating*. St. Louis, Missouri: McGraw Hill, 1971.

B. Durbahn, Walter E. and Robert E. Putnam. *Fundamentals of Carpentry Tools, Materials and Practices*. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

C. Durbahn, Walter E. and Elmer E. Sundberg. *Fundamentals of Carpentry Practical Construction*. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

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E. Putnam, Robert E. and G. E. Carlson. *Architectural and Building Trades Dictionary*. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

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## EXTERIOR FINISH TRIM AND WALL COVERINGS
## SECTION 6.2.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Finish trim items
    A. Roofing materials
    B. Cornice trim boards
    C. Wall coverings
    D. Window and door trim
    E. Special woodwork features

II. Typical Cornice construction
    A. Parts
        1. Ledger
        2. Lookout
        3. Fascia
        4. Plancier (soffit)
        5. Frieze
        6. Wall stud
        7. Rafter
        8. Roof sheathing
        9. Roof shingles
        10. Wall sheathing
    B. Cornice designs
        1. Horizontal box
        2. Sloping box
        3. Open

C. Rake or gable end finish
  1. Short rake extensions
  2. Long rake extensions
D Soffit ventilation

III. Windows
  A. General types
    1. Sliding
    2. Swinging
    3. Fixed
  B. Window sizes
    1. Glass sizes
    2. Sash size
    3. Rough frame opening
    4. Masonry or unit opening

IV. Exterior doors
  A. Entrance doors
    1. Panel
    2. Flush
    3. Metal clad
    4. Sizes
  B. Sliding glass doors
    1. Sizes (consult manufactures literature)
    2. Multiple installations
  C. Garage
    1. Types
      a. Swing up (one piece)

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    3. Texture 1-11
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D. Additional exterior wall covering products

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    4. Asphalt siding
    5. Hardboard siding
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    6. Aluminum siding
    7. Vinyl siding
    8. Stucco
    9. Brick or stone veneer

C. Brick veneer

    1. Types of bonds
        a. Common or full header
        b. Stack
        c. Running
        d. Flemish
        e. Common or flemish header
        f. English cross or dutch
        g. 1/3 running
        h. English

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        b. Steel
        c. Aluminum
        d. Fiberglass
    3. Sizes
        a. Standard widths
        b. Standard heights

V. Exterior wall coverings
  A. Horizontal siding types
    1. Clapboards
    2. Bevel
    3. Rabbeted bevel
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    6. Others
  B. Vertical siding
    1. Board and batten application methods
        a. Standard
        b. T-shaped batten
        c. Board on board
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  C. Plywood siding style
    1. Vee-plank

2. Methods of horizontal layout
    a. Dry bonding
    b. Steel tape bonding
3. Vertical layout
    a. Story pole
    b. Criteria for vertical layout
        1. Location of each course
        2. Location of each mortar joint
        3. Door and window sills
        4. Door and window lintels
        5. Soffit ceiling height
        6. Initial course height variations
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4. Mortar properties (see section 3.1.0, content outline numbers VIII, IX, X, XI, and XII.)
5. Types of leads
    a. Outside corner
    b. Inside corner
    c. Corner pole
6. Types of tooled mortar joints (see section 3.1.0. content outline number XIV.)
7. Bricklaying skill techniques
    a. Loading trowel
    b. Spreading mortar
    c. Building corner leads
    d. Laying stretcher bricks

        e. Metal tees

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VI. Gutters and downspouts

    A. Metal gutter types

        1. Formed

        2. Half-round

    B. Corrugated metal downspouts

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    C. Metal gutter system parts

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        7. "D" end pieces

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        9. "A" elbows

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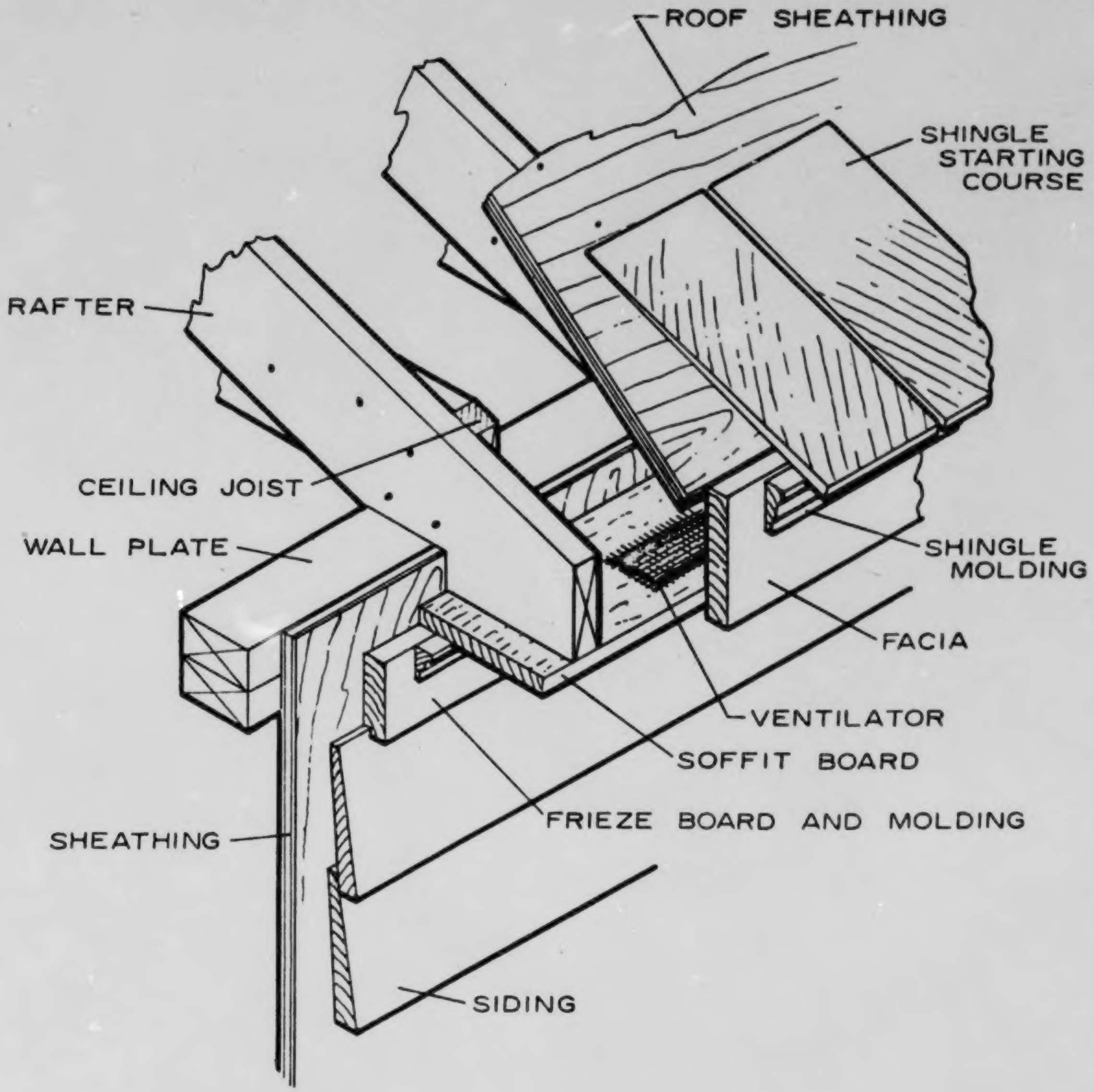
D. Installation information

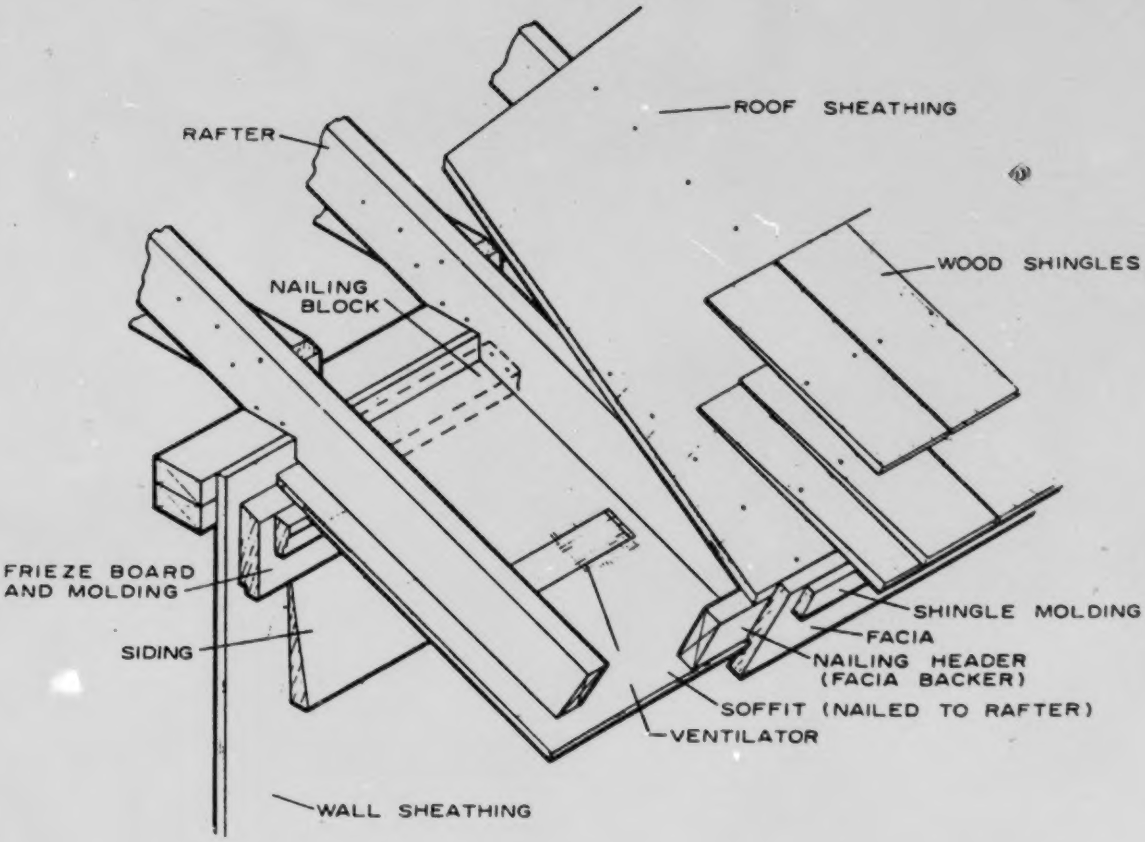
1. Hangers
2. Slope
3. Joint fastening methods
4. Hanger spacing
5. Downspout wall fasteners
6. Splashblock length

# NARROW BOX CORNICE



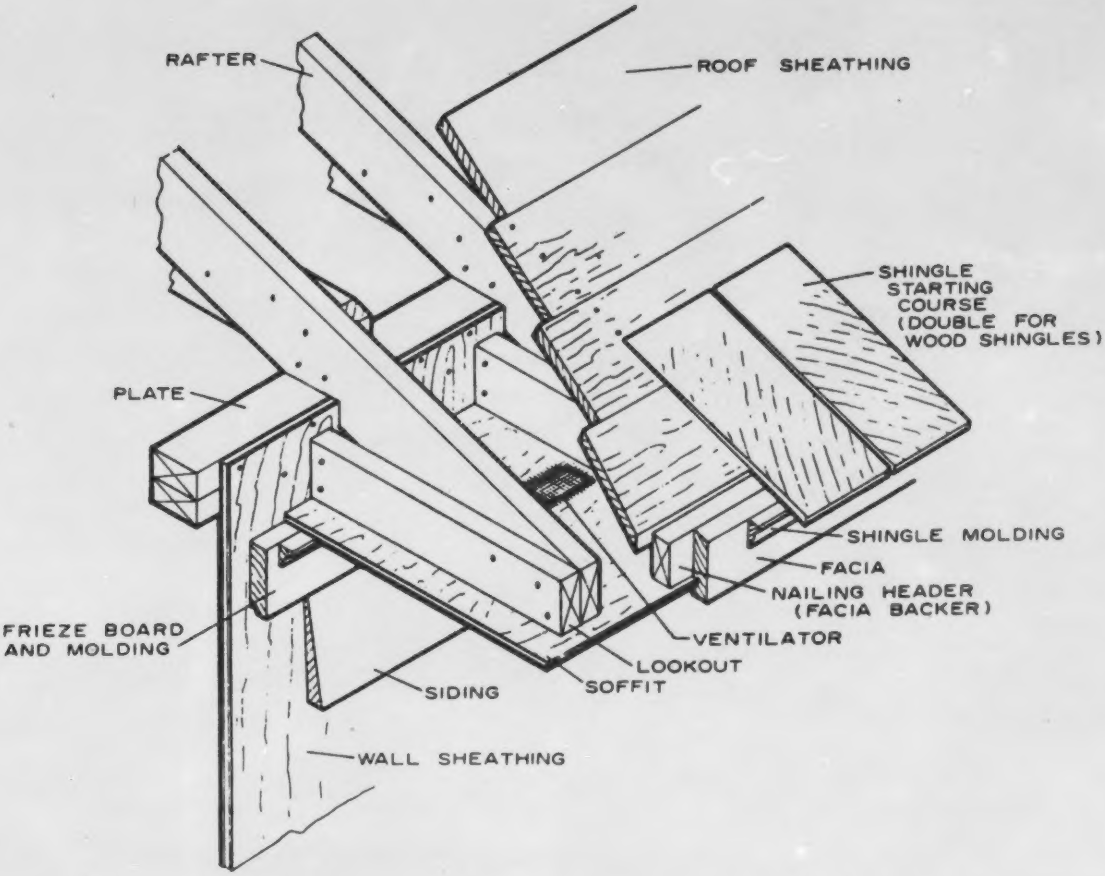
# WIDE BOX CORNICE

(WITHOUT LOOKOUTS)

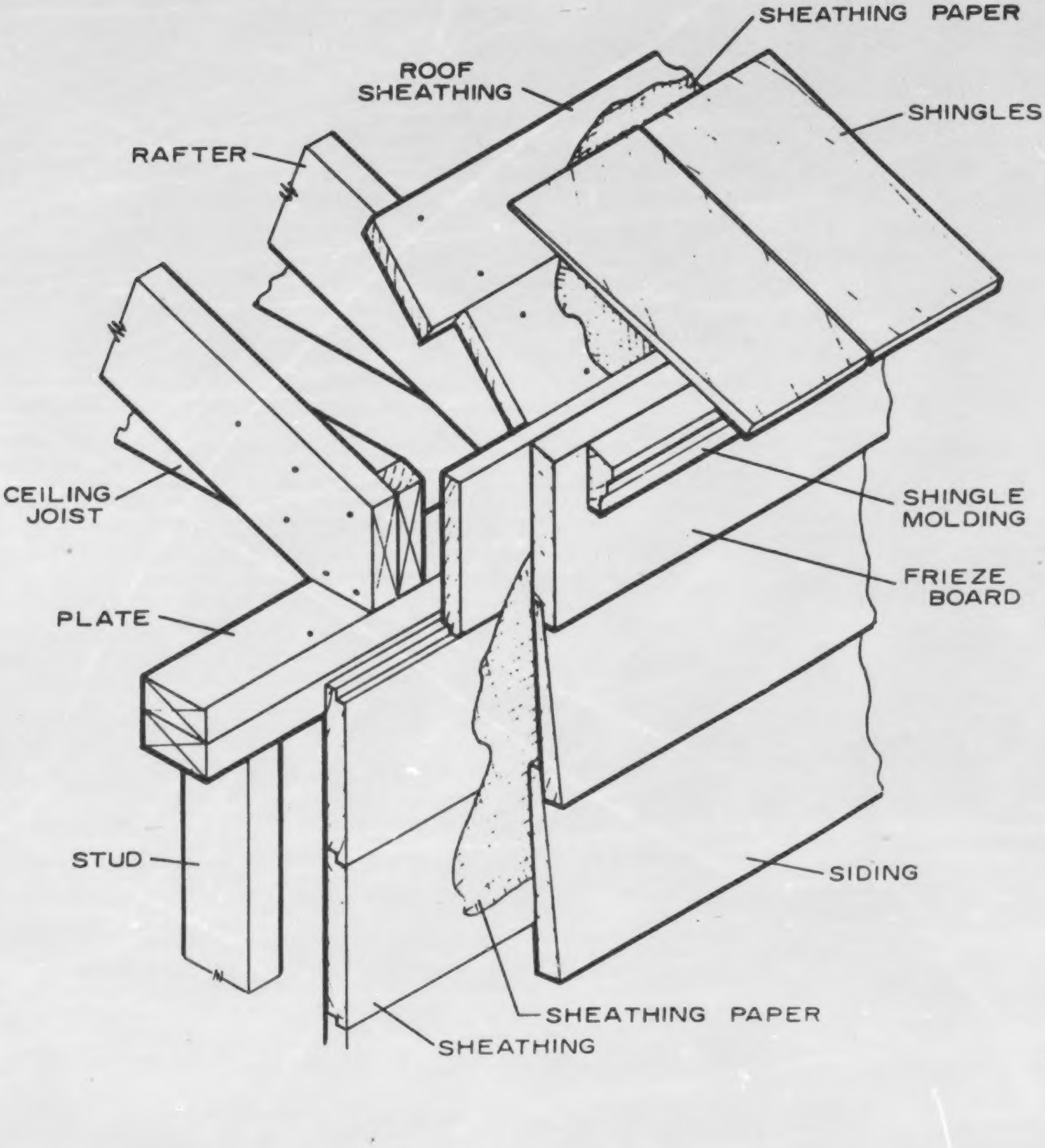


# WIDE BOX CORNICE

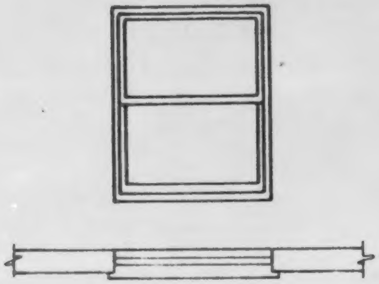
(HORIZONTAL LOOKOUTS)



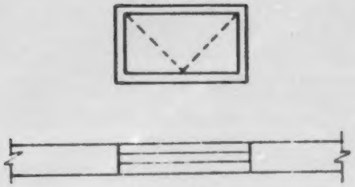
# CLOSE CORNICE



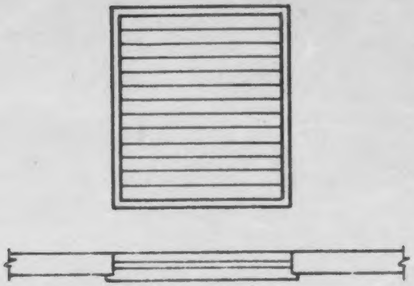
# WINDOW TYPES



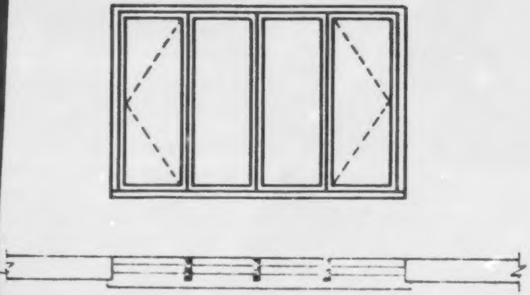
DOUBLE HUNG



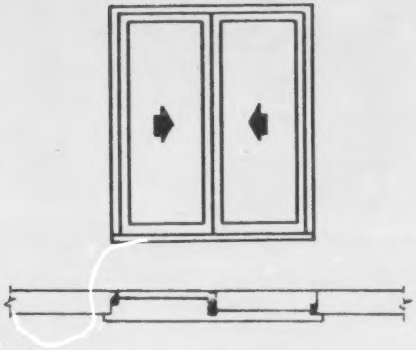
HOPPER



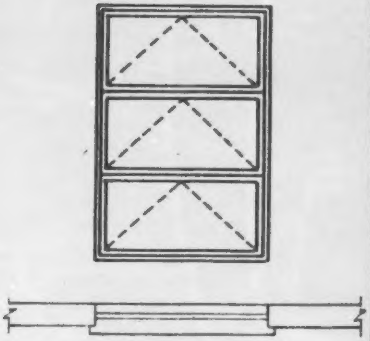
JALOUSIE



CASEMENT

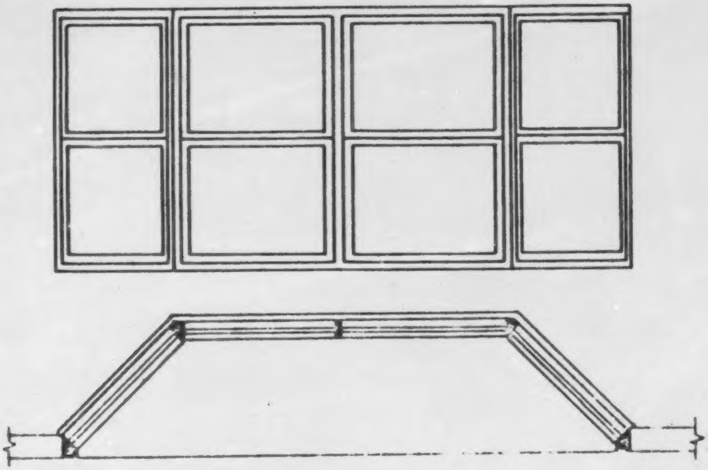


SLIDING

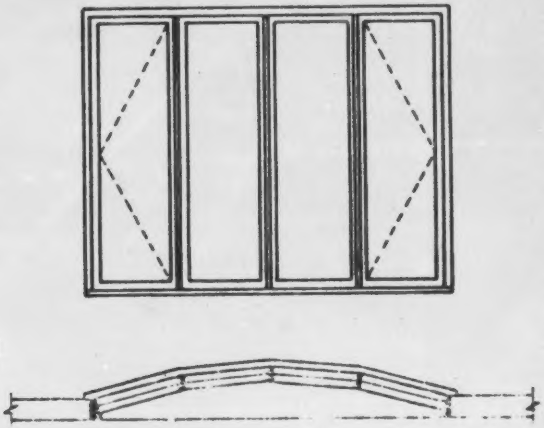


AWNING

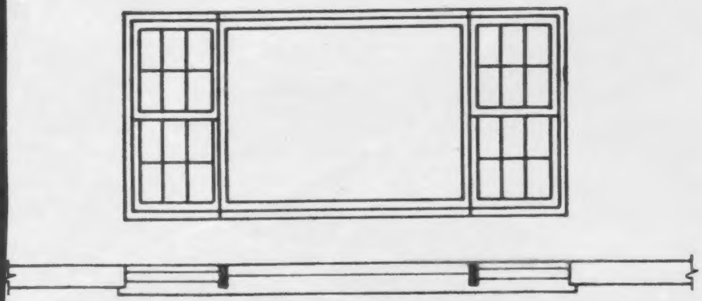
# WINDOW TYPES



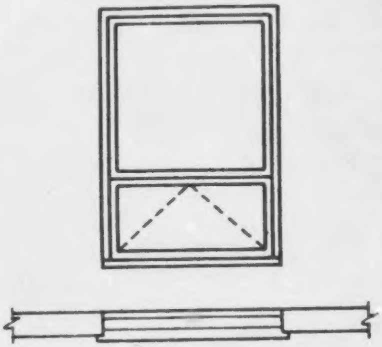
DOUBLE HUNG 45° BAY



CASEMENT BOW

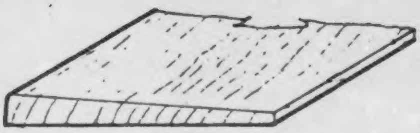
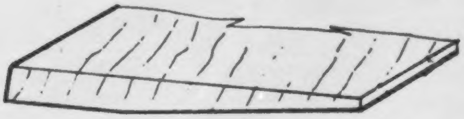
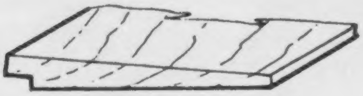
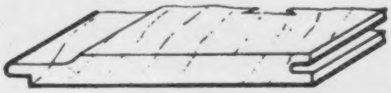
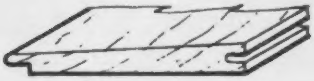


PICTURE WINDOW-DOUBLE
HUNG EACH SIDE

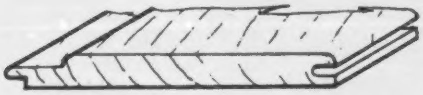
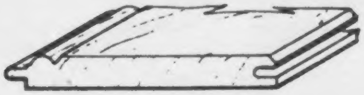


COMBINATION
FIXED AND AWNING

# TYPES OF WOOD SIDING

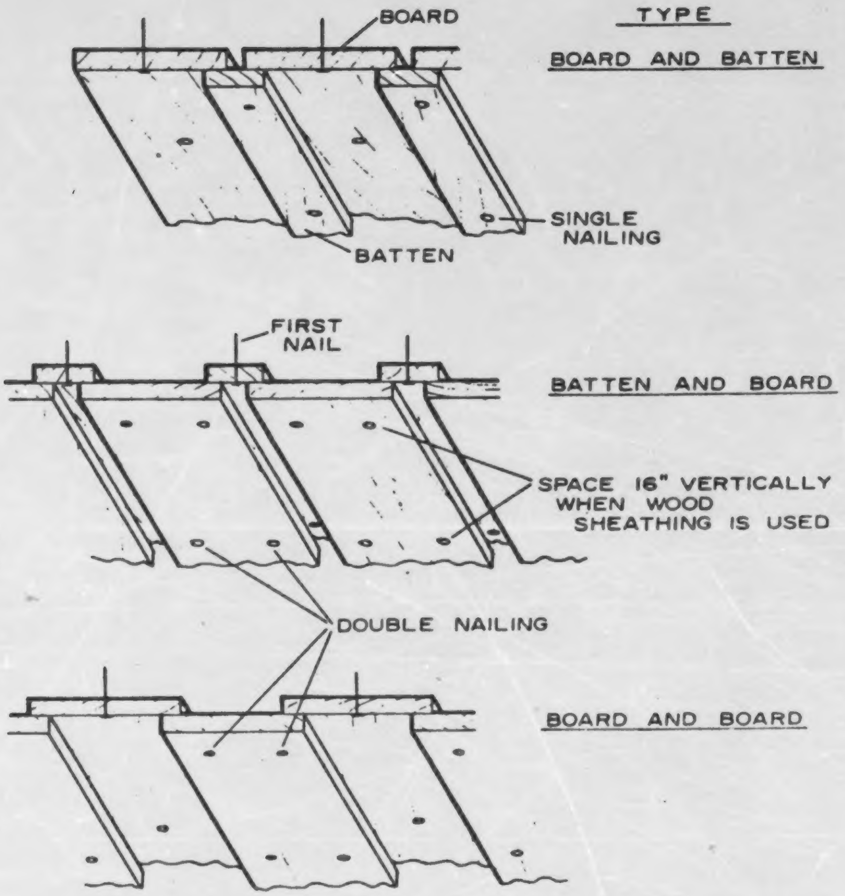
| | TYPE | NOMINAL SIZES |
|---|---|---|
|  | BEVEL | 1/2 x 4 TO<br>3/4 x 10 |
|  | "ANZAC"<br>(BEVEL) | 3/4 x 12 |
|  | DOLLY VARDEN | 3/4 x 6 TO<br>3/4 x 10 |
|  | DROP<br>(PATTERN 106) | 1x6 TO<br>1x8 |
|  | DROP<br>(PATTERN 124) | 1x6 TO<br>1x8 |

HORIZONTAL APPLICATION

| | | |
|---|---|---|
|  | PANELING<br>(WC 130) | 1x4 TO<br>1x12 |
|  | PANELING<br>(WC 140) | 1x4 TO<br>1x12 |

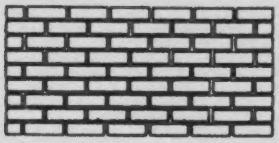
HORIZONTAL OR VERTICAL APPLICATION

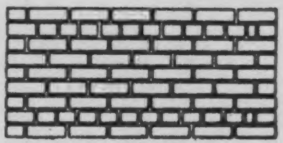
# VERTICAL BOARD SIDING

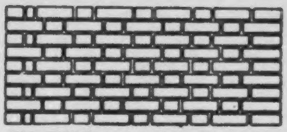


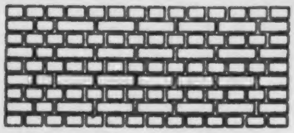
NOTE : NAIL FOR FIRST BOARD - 8d OR 9d
NAIL FOR SECOND BOARD - 12d

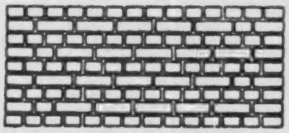
# BASIC PATTERN BONDS


RUNNING BOND


COMMON BOND

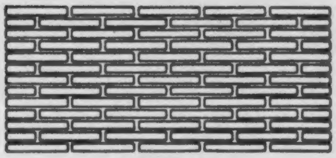

FLEMISH BOND


ENGLISH BOND

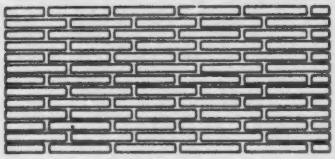

ENGLISH CROSS BOND

COURTESY OF
MCGRAW HILL BOOK CO.
MATERIALS OF CONSTRUCTION
BY R.C. SMITH-1966
IML-UMC

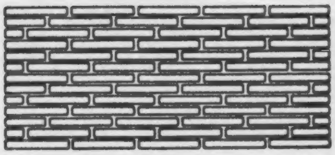
# PATTERNS SUITED TO ROMAN OR NORMAN BRICK



ONE-HALF BOND



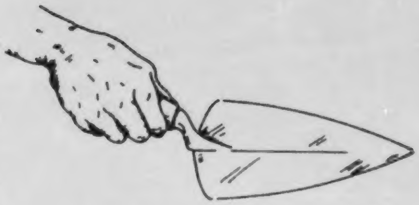
ONE-THIRD BOND



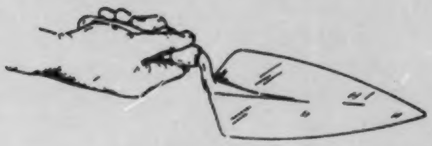
ONE-THIRD BOND DIAGONAL

COURTESY OF
MCGRAW HILL BOOK CO.
MATERIALS OF CONSTRUCTION
BY R.C. SMITH-1966
IML-UMC

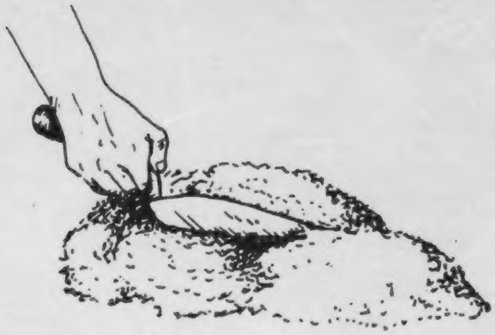
# USING A MASON'S TROWEL



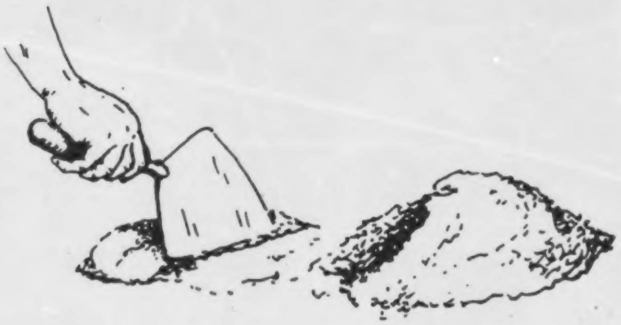
INCORRECT



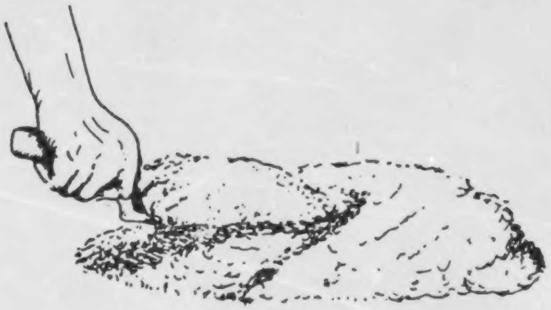
CORRECT



PICKING UP MORTAR FROM THE TUB

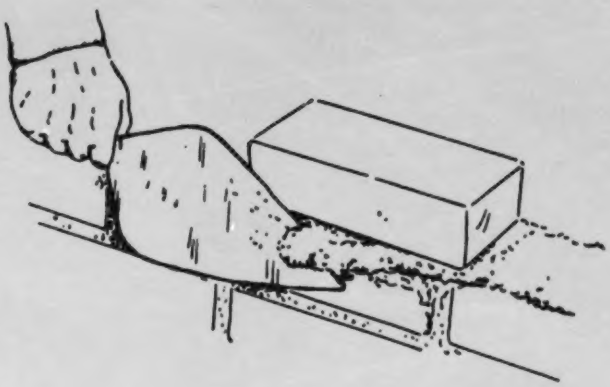


SIDE PICKUP

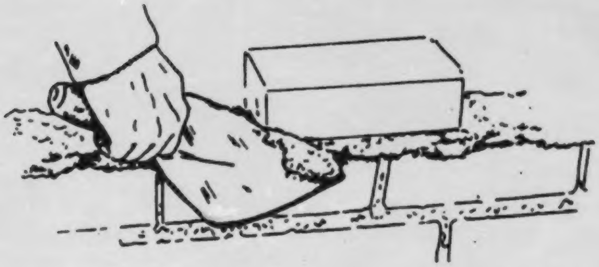


MIDDLE PICKUP

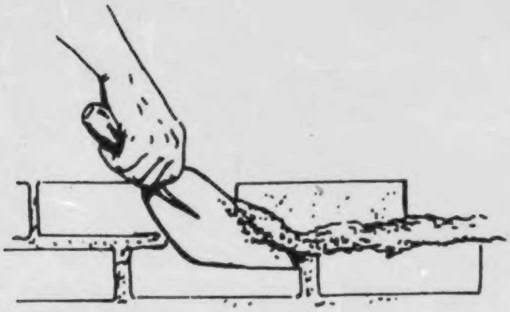
# USING A MASON'S TROWEL



LAYING TO YOUR HAND



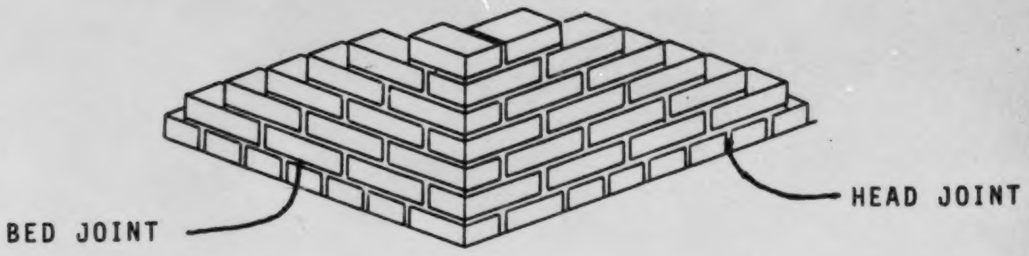
LAYING BACKHAND



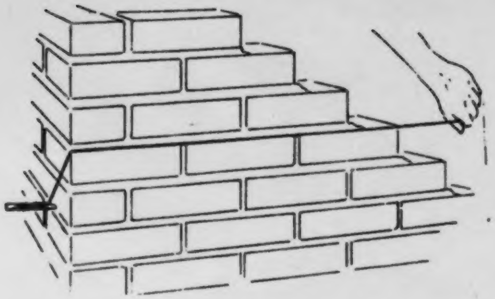
LAYING OVERHAND

6.2.0 - TM 12

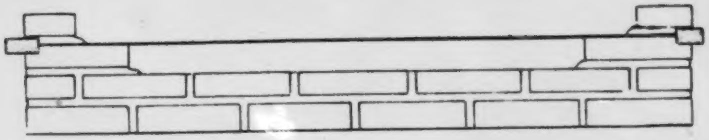
# OUTSIDE CORNER LEAD



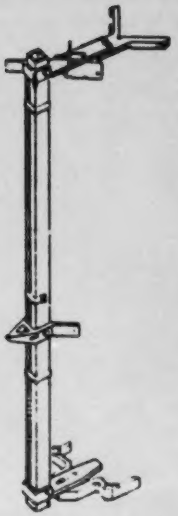
# MASON'S LINE INSTALLATIONS



LINE PINS

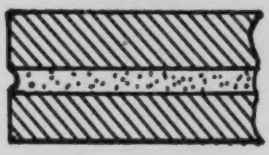


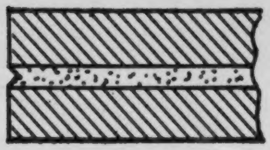
LINE BLOCKS

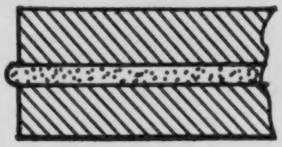


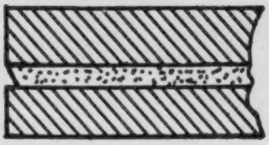
CORNER POLE

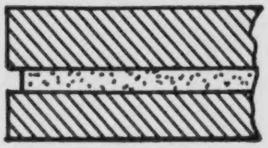
# TOOLED MORTAR JOINTS

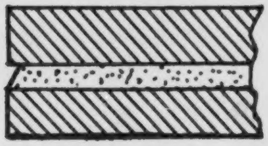

ROUND OR CONCAVE

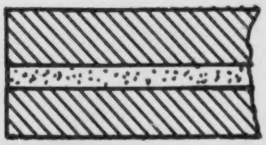

V

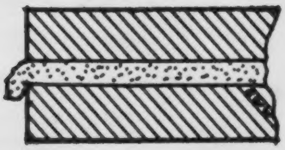

BEADED OR CONVEX


STRUCK


RAKED


WEATHER


FLUSH


EXTRUDED OR WEEPING

# EXTERIOR FINISH TRIM AND WALL COVERINGS
## SECTION 6.2.0

## ASSIGNMENT SHEET #1 - MATERIAL ESTIMATING

Calculate the following materials for the building illustrated below.

__________1. 2 x 4's 16 feet long for lookouts

__________2. 1 x 4's 16 feet long for lookout ledger

__________3. Running feet of 1 x 8 fascia

__________4. Sheets of 1/4 x 4' x 8' exterior Fir plywood for the plancier (soffit)

__________5. Square feet of 12" square edged siding needed disreguarding window and door openings (allow 15% for overlap and waste)

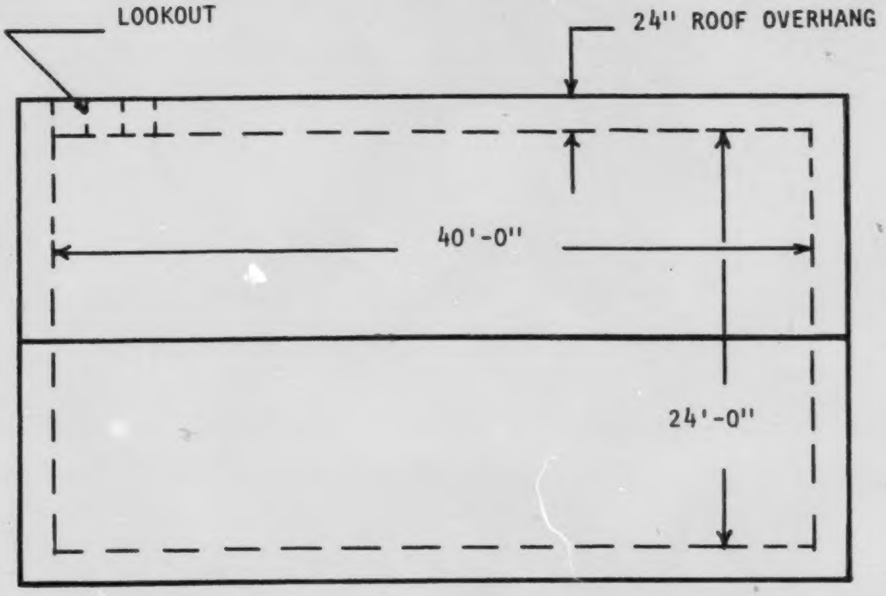
__________6. Running feet of molding for frieze

SPECIFICATIONS:

Roof rafters 24" on center

Exterior wall height for siding 8' - 0"

Roof slope 4/12



## EXTERIOR FINISH TRIM AND WALL COVERINGS
## SECTION 6.2.0

### ASSIGNMENT SHEET #2 - MASONRY TERMS AND DEFINITIONS

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

_____1. Section of wall built in advance to determine wall lines and elevation

_____2. Sheet metal of special shapes and designs to be used at various sections of the wall for water proofing

_____3. Method of ascertaining brick bond by laying brick without mortar

_____4. Wall that supports the floors and roof of the building

_____5. Length of 1" x 2" piece of wood with brick courses marked on it and other elevation details pertaining to a certain wall section

_____6. Meaning that the wall is high enough to warrant the use of scaffolding to continue construction of the wall

_____7. Process designed to beautify and help weatherproof the mortar joint

_____8. Pattern to which bricks are laid

_____9. Temporary structure or platform to support workman and material during construction

_____10. Piece of steel used to support masonry units over windows and door openings

_____11. Procedure to establish wall lines, bonds, openings, elevations and type of wall to be constructed

a. Load-bearing wall

b. Scaffold high

c. Lintel

d. Parging

e. Wythe

f. Flashing

g. Nonload-bearing wall

h. Tooling

i. Story pole

j. Lead

k. Layout

l. Brick bond

m. Scaffold

n. Grout

o. Dry bonding

_____12. Process of applying a layer of mortar to the vertical face of masonry units.

_____13 Wall that has no structural tie to the building by allowing floors or roofs to bear their weight on it.

_____14. Continuous section of masonry, one unit in thickness.

_____15. Thin mortar which will pour without separation of ingredients.

## EXTERIOR FINISH TRIM AND WALL COVERINGS
## SECTION 6.2.0

### ANSWERS TO ASSIGNMENTS #1 AND #2

Assignment sheet #1

1. 6
2. 5
3. 148
4. 9
5. 1,178
6. 80

Assignment sheet #2

1. j
2. f
3. o
4. a
5. i
6. b
7. h
8. l
9. m
10. c
11. k
12 d
13. g
14. e
15. n

## STATEMENT OF OBJECTIVES

UNIT 7.0.0 PLUMBING - ROUGH IN

SECT. 7.1.0 Waste Disposal System

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL IDENTIFY THE MAIN COMPONENTS AND SIZE REQUIREMENTS OF A RESIDENTIAL WASTE DISPOSAL SYSTEM, PREPARE ROUGH-IN FOR THE INSTALLATION OF COMMONLY USED PLUMBING FIXTURES, JOIN VARIOUS TYPES OF PIPING FOR DRAINAGE PURPOSES AND TEST THE WASTE DISPOSAL SYSTEM FOR LEAKS.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

7.1.1 Write the names of the four (4) main parts of a waste disposal system and explain the function of each.

7.1.2 List the size requirements for the four (4) main parts of a waste disposal system as specified by the local or National Plumbing Code.

7.1.3 Write a minimum of six (6) pipe products generally used for drainage and ventilation requirements of residential plumbing installations.

7.1.4 List six (6) plumbing fixtures generally included in single family residences and the soil or waste pipe sizes (diameters) considered minimum as specified by the National Plumbing Code or HUD Minimum Property Standards.

7.1.5 Layout the location of all fixtures requiring soil or waste connections.

NOTE: LABEL USING A HEAVY LINE MARKER FOR EASY IDENTIFICATION.

7.1.6 Layout the location of all vents as required by the local and/or National Plumbing Code and label.

7.1.7 Join rigid copper drainage pipe and fittings using solder to make a watertight joint.

7.1.8 Join cast iron soil pipe to fittings using neoprene gaskets.

> NOTE: LEAD-OAKUM JOINTS ARE GROWING OUT
> OF FAVOR BECAUSE OF SIMPLER AND
> MORE RAPID METHODS OF INSTALLING
> WASTE AND SOIL DISPOSAL PIPING.

7.1.9 Join plastic drainage pipe PVC (polyvinyl chloride/polyvinyl dichloride) or ABS (acrylonitrile butadine styrene) into watertight joints using a chemical to construct a solvent-welded joint.

7.1.10 Cut or bore and frame the necessary openings in walls, floors, ceilings and roof for soil, waste and vent pipe installations. Ascertain opening size and hole diameters from drainage pipe measurements.

7.1.11 Install bath tub or combination shower and bath tub unit according to instructions furnished with unit.

7.1.12 Select pipe to be used from the plumbing plans for the waste disposal system. Layout, cut and join pipes and fittings to form the soil stack and vent. Assemble in place and extend through ceiling and roof.

7.1.13 Complete soil installation for water closets by connecting closet floor flange to soil pipe and extending soil drain pipe to T previously placed in main soil stack.

7.1.14 Complete connection of waste installations to main soil stack from all other fixtures producing liquid waste water. Include P-traps and cleanout as specified by local or National Plumbing Code.

7.1.15 Vent each plumbing fixture through the roof as specified by the local plumbing code/National Plumbing Code or HUD Minimum Property Standards.

7.1.16 Extend the house drain from the base of the main soil stack through the exterior foundation wall the specified distance below grade.

7.1.17 List four kinds of pipe generally used for sewer installations between a residential structure and the community sewer or septic tank. Specify the type of connecting joint used with each.

7.1.18 Excavate a trench and install the house sewer from the house drain (extending throught the foundation wall) to the community sewer line or septic tank.

7.1.19 Explain in writing how a plumber would conduct a water, air and smoke test for a waste disposal system.

# INSTRUCTIONAL FORMAT

UNIT 7.0.0 PLUMBING - ROUGH IN

SECT. 7.1.0 Waste Disposal System

## INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

   A. Provide learner with statement of objectives sheet

   B. Discuss terminal and specific objectives

   C. Provide learner with instruction sheets for use with this section

   D. Explain evaluation procedures

II. Suggested instructional methods:

   A. Demonstration - to show manipulative operations at construction site

   B. Discussion - to encourage question and answer activities

   C. Team assignment - to enhance personal relationships in the work environment.

   D. Illustrated lecture - to introduce a lesson or focus attention

   E. Field trips - to illustrate construction techniques and application of materials

   F. Consultant - journeyman trade craftsman for presentation of personal qualifications, training and employment opportunities.

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Supply/Drainage System
  - 2. TM 2 - Typical Single Stack Group Venting and Drainage
  - 3. TM 3 - Typical Water Closet Drainage
  - 4. TM 4 - Typical Lavatory Drain
  - 5. TM 5 - Typical Bathtub Drainage
  - 6. TM 6 - Typical Kitchen Sink Drainage
  - 7. TM 7 - Typical Kitchen Sink With Disposer Drainage
- D. Assignment sheet #1 - Material Identification
- E. Answers to assignment sheet #1

IV. References:

- A. D'Anchangelo, B. D., D'Anchangelo, B. F., and Gust, J. R. Blueprint Reading for Plumbers - Residential/Commercial. Albany, New York: Delmar Publishers, 1973.
- B. Illinois Department of Public Health. "Illinois State Plumbing Code". Springfield, Illinois, 1976.
- C. Kicklighter, Cloise E. Architecture: Residential Drawing and Design. South Holland, Illinois: Goodheart Willcox Company, 1973.
- D. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: Goodheart Willcox Company, Inc., 1976.
- E. Putnam, Robert, and G. E. Carlson. Architectural and Building Trades Dictionary. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.
- F. Ripka, L. V. Plumbing Installation and Design. Chicago, Illinois: American Technical Society, 1978.
- G. Spence, William P. Architecture: Design Engineering Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# WASTE DISPOSAL SYSTEM
## SECTION 7.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Major parts of plumbing system
   A. Waste disposal system
   B. Fresh water distribution system

II. Waste disposal system major parts
   A. Soil pipe
      1. Function
      2. Size
   B. Waste pipes
      1. Function
      2. Size
   C. Building drain
      1. Function
      2. Size
   D. Building sewer
      1. Function
      2. Size

III. Types of pipe products for drainage and ventilation
   A. Cast iron
   B. Copper tubing types
      1. K
      2. L
      3. M
      4. DWV

C. Wall thickness

D. System for sizing (actual inside diameter plus 1/8")

F. Plastic pipe types

  1. ABS (Acrylonitrile-Butadine-Styrene)

  2. PVC (Polyvinyl Chloride)

  3. CPVC (Chlorinated Polyvinyle Chloride)

  4. PE plastic tubing (Polyethylene)

F. Galvanized steel and fittings

G. Fiber pipe and fittings

IV. Basic residential plumbing fixtures and minimum soil and waste pipe diameter

A. Bathtub

  1. Waste size

  2. Vent size

B. Water closet

  1. Soil size

  2. Vent size

C. Lavatory

  1. Waste size

  2. Vent size

D. Kitchen sink

  1. Waste size

  2. Vent size

E. Shower

  1. Waste size

  2. Vent size

F. Laundry tub or automatic washer

1. Waste size

2. Vent size

V. Fixture location for soil and waste connections

A. Allowances for wall materials

B. Bath fixture locations

1. Water closet

2. Lavatory

3. Bathtub

4. Fiberglass tub and shower units

C. Assitional support measures

1. Cutting floor moists

2. Notching wall studs

3. Lavatory blocking

4. Bathtub blocking

5. Wall-hung water closet support

D. Kitchen fixtures

E. Laundry fixtures

VI. Venting system

A. Purposes

1. Maintain atmospheric pressure in waste piping

2. Exhausts sewer gas

3. Prevents siphonage

B. Venting methods

1. Individual

2. Unit

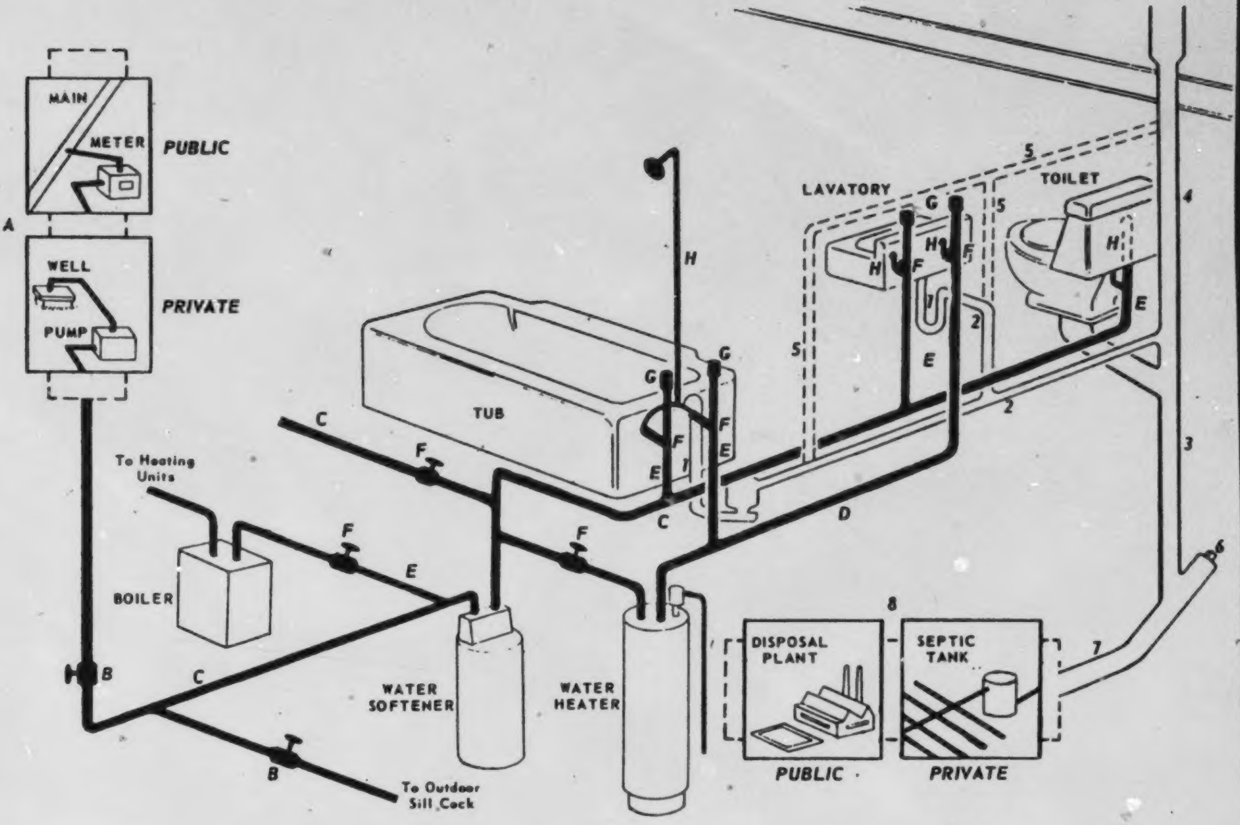
        3. Circuit
        4. Wet
        5. Looped

VII. Methods of joining DWV (drain, waste and vent) piping materials
    A. Solder
    B. Neoprene gaskets
    C. Lead-oakum (growing out of use)
    D. Gasket and clamp
    E. Plastic chemicals

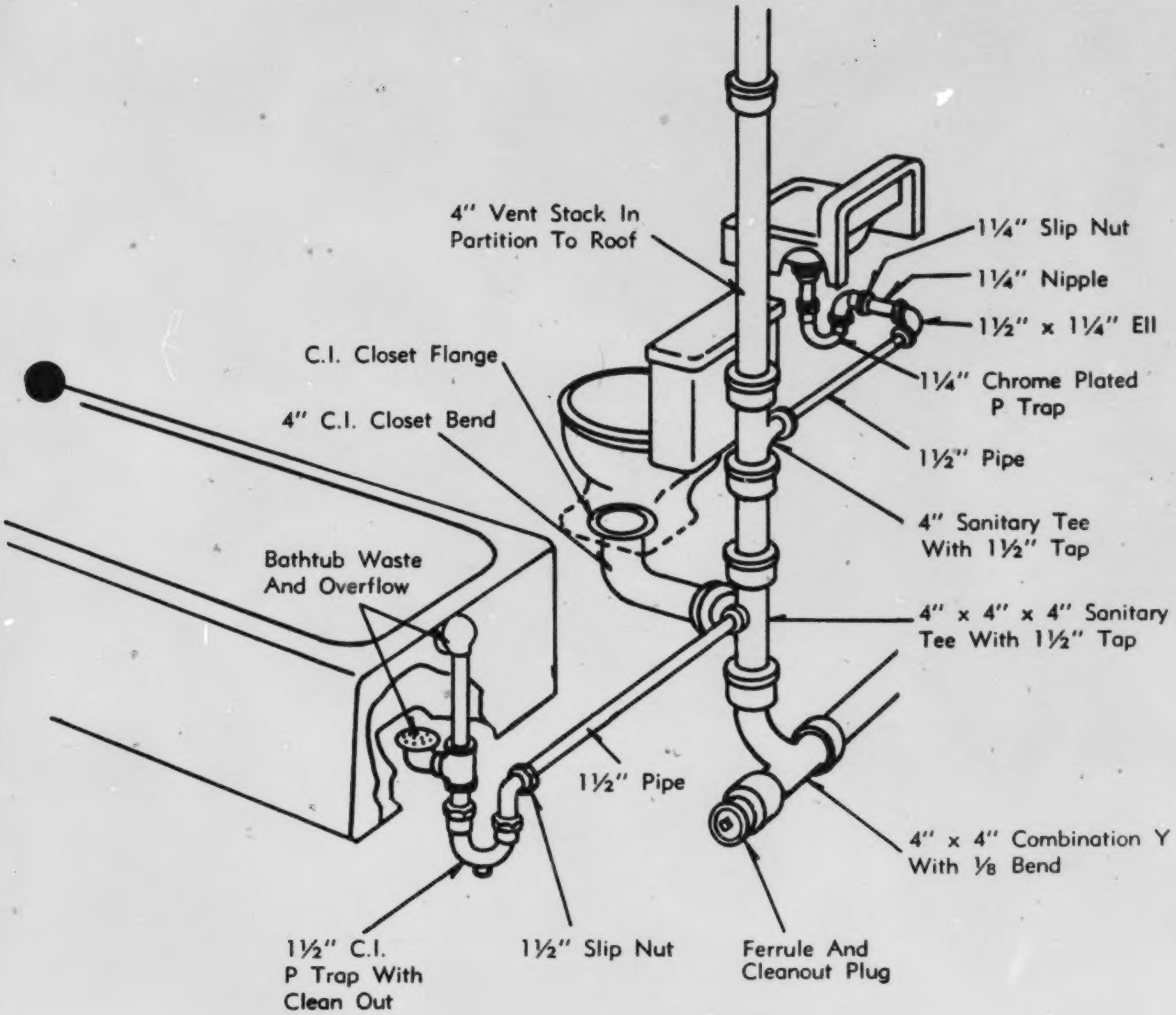
VIII. Kinds of sewer pipe
    A. Vitrified clay tile
    B. Cast iron
    C. Plastic (PVC)
    D. Fiber pipe

IX. Testing drainage piping systems
    A. Water test specifications for DWV
        1. Minimum water head (10 ft.)
        2. Vent stack utilization
    B. Air testing specification for DWV (5 psi)
    C. Smoke test specifications
        1. Air pressure requirement (1 inch of water column)
        2. Time (15 minutes)
    D. Peppermint leak detection
    E. Freon gas leak detection

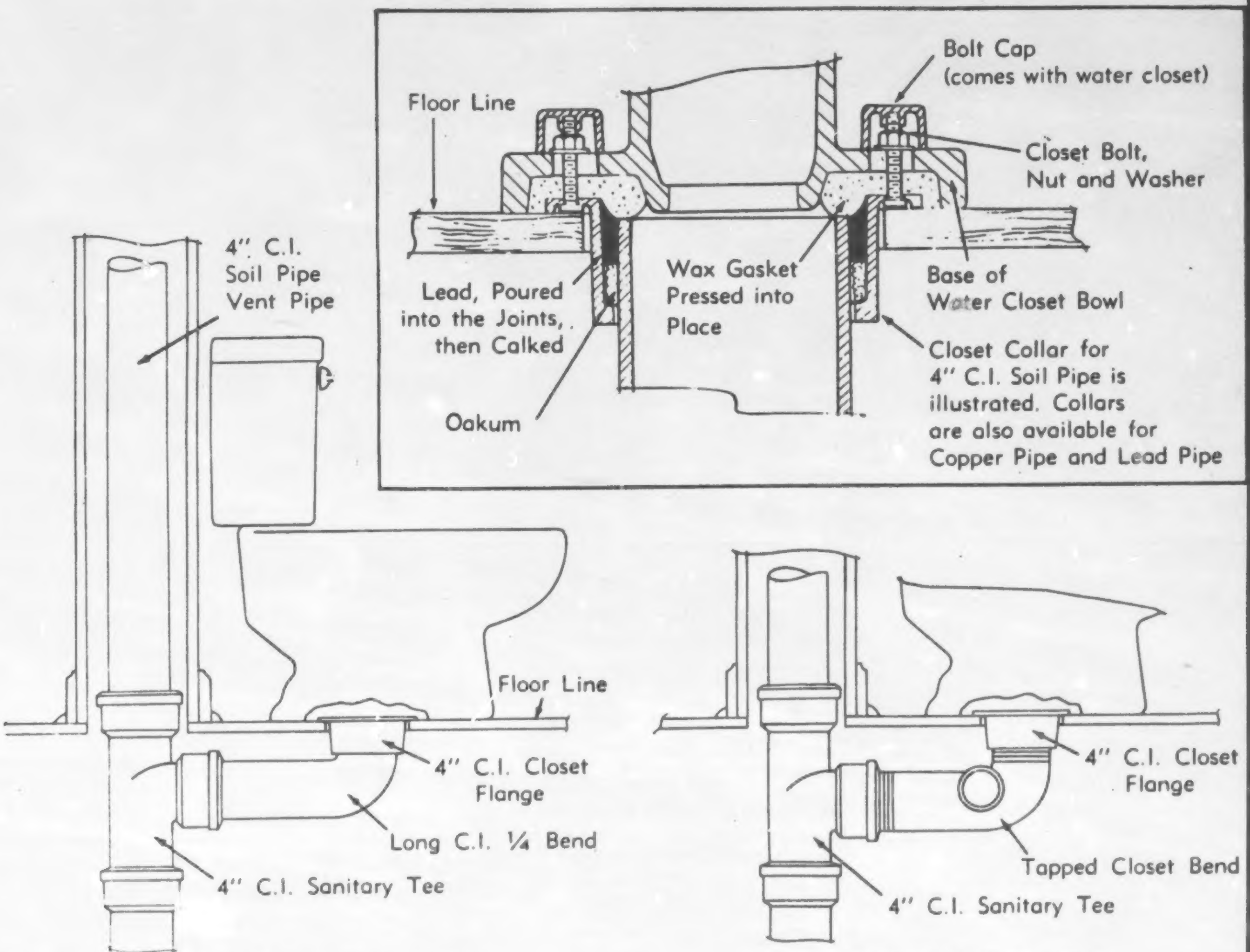
# SUPPLY/DRAINAGE SYSTEM



# TYPICAL SINGLE STACK GROUP VENTING AND DRAINAGE


4" Vent Stack In Partition To Roof
1¼" Slip Nut
1¼" Nipple
1½" x 1¼" Ell
C.I. Closet Flange
1¼" Chrome Plated P Trap
4" C.I. Closet Bend
1½" Pipe
4" Sanitary Tee With 1½" Tap
Bathtub Waste And Overflow
4" x 4" x 4" Sanitary Tee With 1½" Tap
1½" Pipe
4" x 4" Combination Y With ⅛ Bend
1½" C.I. P Trap With Clean Out
1½" Slip Nut
Ferrule And Cleanout Plug

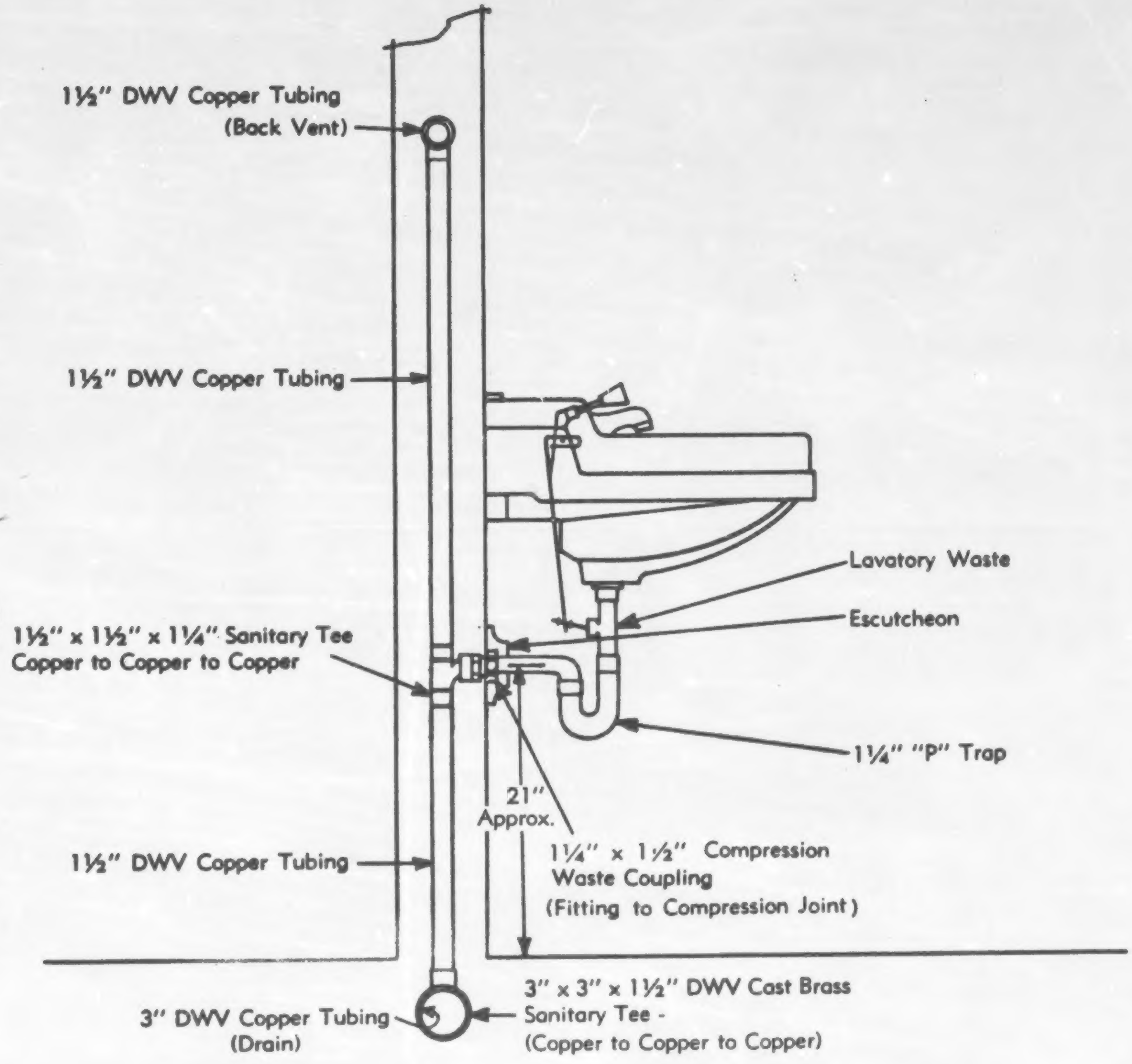
# TYPICAL WATER CLOSET DRAINAGE


Bolt Cap
(comes with water closet)
Floor Line
Closet Bolt, Nut and Washer
Wax Gasket Pressed into Place
Base of Water Closet Bowl
Lead, Poured into the Joints, then Calked
Oakum
Closet Collar for 4" C.I. Soil Pipe is illustrated. Collars are also available for Copper Pipe and Lead Pipe
4" C.I. Soil Pipe Vent Pipe
Floor Line
4" C.I. Closet Flange
Long C.I. ¼ Bend
4" C.I. Sanitary Tee
4" C.I. Closet Flange
Tapped Closet Bend
4" C.I. Sanitary Tee

WITH CAST IRON DRAINAGE FITTINGS

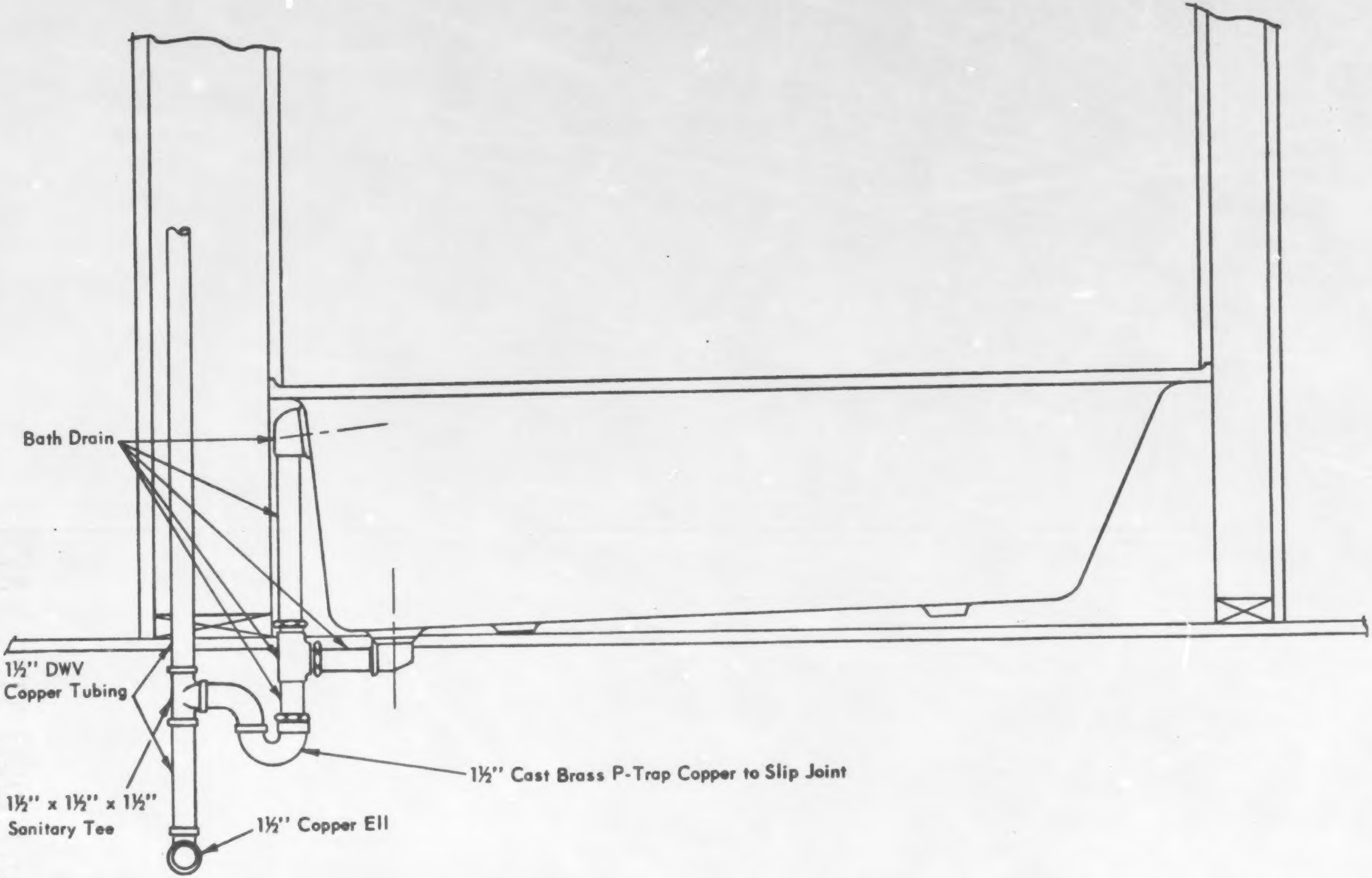
WITH TAPPED CLOSET BEND

# TYPICAL LAVATORY DRAIN



LAVATORY DRAINAGE SYSTEM
CONNECTED TO COPPER DWV DRAINAGE TUBING

# TYPICAL BATHTUB DRAINAGE


Bath Drain
1½" DWV Copper Tubing
1½" Cast Brass P-Trap Copper to Slip Joint
1½" x 1½" x 1½" Sanitary Tee
1½" Copper Ell

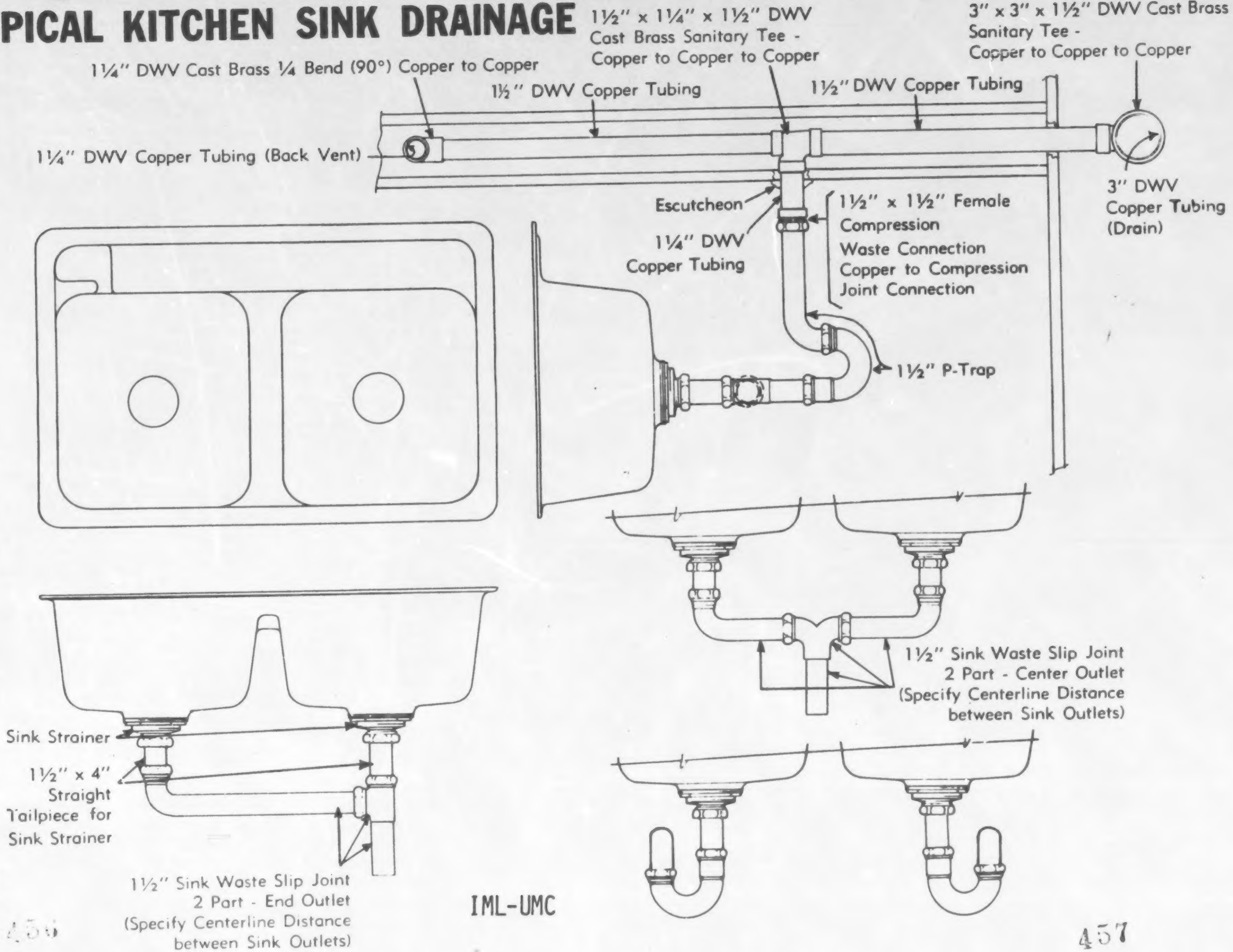
7.1.0 - TM 5

IML-UMC

RECESS TUB INSTALLATION USING DWV COPPER TUBE DRAINAGE SYSTEM

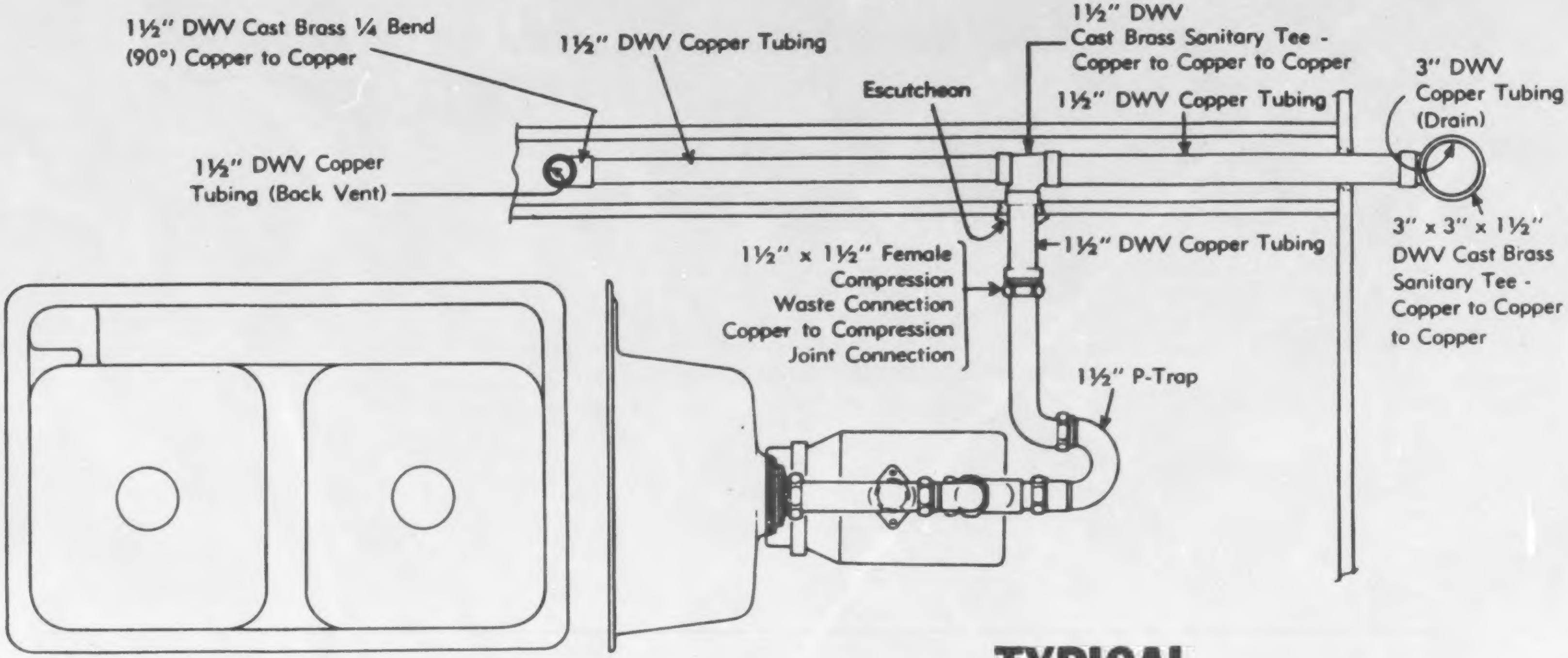
454

# TYPICAL KITCHEN SINK DRAINAGE


1½" x 1¼" x 1½" DWV Cast Brass Sanitary Tee - Copper to Copper to Copper
3" x 3" x 1½" DWV Cast Brass Sanitary Tee - Copper to Copper to Copper
1¼" DWV Cast Brass ¼ Bend (90°) Copper to Copper
1½" DWV Copper Tubing
1½" DWV Copper Tubing
1¼" DWV Copper Tubing (Back Vent)
3" DWV Copper Tubing (Drain)
Escutcheon
1¼" DWV Copper Tubing
1½" x 1½" Female Compression Waste Connection Copper to Compression Joint Connection
1½" P-Trap
1½" Sink Waste Slip Joint 2 Part - Center Outlet (Specify Centerline Distance between Sink Outlets)
Sink Strainer
1½" x 4" Straight Tailpiece for Sink Strainer
1½" Sink Waste Slip Joint 2 Part - End Outlet (Specify Centerline Distance between Sink Outlets)

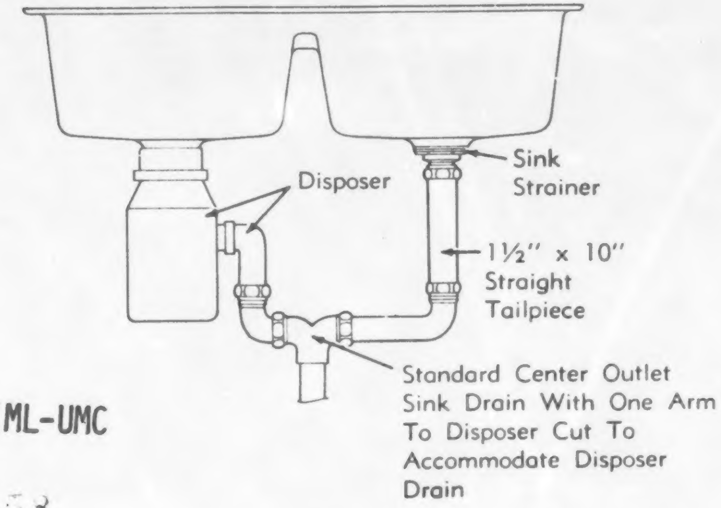
7.1.0 - TM 6

IML-UMC


1½" DWV Cast Brass ¼ Bend (90°) Copper to Copper
1½" DWV Copper Tubing
1½" DWV Cast Brass Sanitary Tee - Copper to Copper to Copper
Escutcheon
1½" DWV Copper Tubing
3" DWV Copper Tubing (Drain)
1½" DWV Copper Tubing (Back Vent)
1½" DWV Copper Tubing
3" x 3" x 1½" DWV Cast Brass Sanitary Tee - Copper to Copper to Copper
1½" x 1½" Female Compression Waste Connection Copper to Compression Joint Connection
1½" P-Trap

# TYPICAL KITCHEN SINK with DISPOSER DRAINAGE

## KITCHEN SINK DRAINAGE SYSTEM USING COPPER DRAINAGE TUBING


Disposer
Sink Strainer
1½" x 10" Straight Tailpiece
Standard Center Outlet Sink Drain With One Arm To Disposer Cut To Accommodate Disposer Drain

## WASTE DISPOSAL SYSTEM
### SECTION 7.1.0

### ASSIGNMENT SHEET #1 - MATERIAL IDENTIFICATION

Identify each of the parts shown in the following figures.

1. Name the parts of the typical cast-iron stack assembly shown below:

a. ______________________________

b. ______________________________

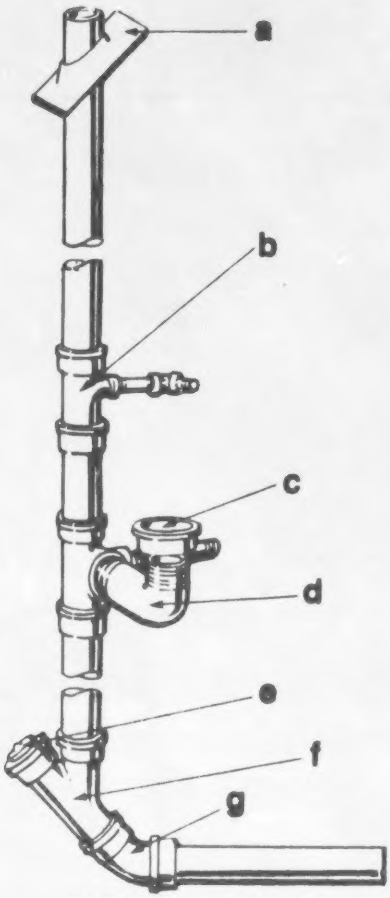
c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________



TYPICAL CAST-IRON
STACK ASSEMBLY

2. Name the parts of the typical copper stack assembly shown below:

a.________________________________

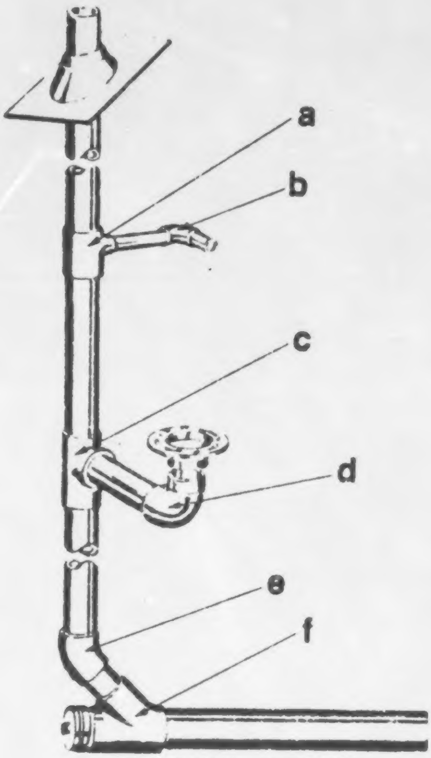
b.________________________________

c.________________________________

d.________________________________

e.________________________________

f.________________________________



TYPICAL COPPER
STACK ASSEMBLY

## WASTE DISPOSAL SYSTEM
## SECTION 7.1.0

## ANSWERS TO ASSIGNMENT #1

1. a. Root flashing
   b. Tapped sanitary tee
   c. Closet flange
   d. Tapped closet bend
   e. Cleaning ferrule
   f. $45^{\circ}$-Y Branch
   g. 1/8 Bend

2. a. Sanitary tee
   b. $90^{\circ}$ Street elbow
   c. Sanitary tee
   d. Closet bend
   e. 1/8 Bend
   f. $45^{\circ}$-Y Branch

## STATEMENT OF OBJECTIVES

UNIT 7.0.0 PLUMBING - ROUGH IN

SECT. 7.2.0 Fresh Water Distribution System

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL IDENTIFY THE PRIMARY CONPONENTS AND SIZE REQUIREMENTS OF A RESIDENTIAL WATER SUPPLY SYSTEM, PREPARE WATER SUPPLY ROUGH IN TO COMMONLY USED WATER CONSUMING PLUMBING FIXTURES AND JOIN THE MOST COMMONLY USED TYPES OF WATER SUPPLY PIPING.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

7.2.1 List minimum size water supply pipes for fixtures generally installed in residential structures. Include bathtubs, laundry tub, dishwasher, kitchen sink, lavatory, shower, service sink, water closet (tank type), hose bibbs and water heater.

7.2.2 List three kinds of pipe generally used in the construction of cold water distribution systems including one advantage and disadvantage of each.

7.2.3 Join rigid type L cooper water supply pipes and fittings using solder to construct a water tight joint.

7.2.4 Join galvanized iron water supply pipes and fittings by cutting an American Standard taper pipe thread and joining to construct a water tight joint.

7.2.5 Join plastic water supply pipes and fittings using a chemical to construct a solvent welded water tight joint.

7.2.6 Write three criteria that must be observed when planning the location of the exterior water service line to a residential structure.

7.2.7 Layout and excavate a trench to specified depth and install water service supply line.

7.2.8 Layout and bore holes for all water supply pipes at fixture locations.

7.2.9 Install all fixture fittings (usually tub and shower) in place that are covered by the interior wall covernings and extend water supply risers through the floor for connection to the water supply main via branch lines.

7.2.10 Fabricate and secure in position all concealed (within walls) water supply risers that service fixtures with trim not concealed within the wall. Extend water supply risers through the floor for connection to the water supply main via branch lines.

NOTE: THE INSTALLATION OF A WATER SERVICE SUPPLY LINE TO THE STRUCTURE HAS PREVIOUSLY BEEN LISTED AS PERFORMANCE OBJECTIVE 3.1.8 LOCATED IN UNIT III BECAUSE OF THE NEED FOR WATER EARLY IN THE CONSTRUCTION PROCESS.

7.2.11 Install a 3/4 inch diameter cold water supply main suspended below the first floor. Extend the main sufficient distance to install branch lines to each fixture using cold water.

7.2.12 Install cold water branch lines to previously installed risers at each fixture location.

7.2.13 Install the water distribution system on a slight grade to facilitate gravity draining by placing a drain valve at the low point in the system.

7.2.14 Install a hot water supply main, 3/4 inches in diameter, suspended below the first floor joist. Begin the main at the hot water heater outlet and extend the main far enough to facilitate the installation of branch hot water lines to each consuming fixture.

7.2.15 Install hot water branch lines to previously installed risers at each fixture location.

## INSTRUCTIONAL FORMAT

UNIT 7.0.0 PLUMBING - ROUGH IN

SECT. 7.2.0 Fresh Water Distribution System

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - journeyman trade craftsman or plumbing contractor

III. Instructional materials included in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Supply/Drainage System (see 7.1.0-TM 1)
  - 2. TM 2 - Typical Water Closet Supply
  - 3. TM 3 - Typical Lavatory Supply
  - 4. TM 4 - Typical Bathtub Supply System
  - 5. TM 5 - Typical Kitchen Sink Supply
- D. Assignment sheet #1 - Material Identification
- E. Answers to assignment sheet #1

IV. References:

A. D'Anchangelo, B. D., D'Anchangelo, B. F. and Gust, J. R. Blueprint Reading for Plumbers - Residential/Commercial. Albany, New York: Delmar Publishers, 1973.

B. Kicklighter, Cloise E. Architecture: Residential Drawing and Designs. South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.

C. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: Goodheart Willcox Company, Inc., 1976.

D. Putnam, Robert and G. E. Carlson, Architectural and Building Trades Dictionary. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

E. Ripka, L. V. Plumbing Installation and Design. Chicago, Illinois: American Technical Society, 1978.

F. Spence, William P. Architecture: Design Engineering Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# FRESH WATER DISTRIBUTION SYSTEMS
## SECTION 7.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Parts of water distribution system

  A. Cold water system

    1. Water service supply pipe

    2. House main

    3. Branch pipes

    4. Risers

  B. Hot water system

    1. Types

    2. House main

    3. Branch pipes

    4. Risers

II. Types of pipe products for water supply systems

  A. Galvanized steel or iron

  B. Rigid copper, type L

  C. Plastic

  D. Advantages and disadvantages of piping materials

III. Basic residential plumbing fixtures and minimum size water branch pipe

  A. Water service (3/4")

  B. Other generally 1/2 inch

IV. Joining water supply piping materials

  A. Solder

  B. Solvent weld

  C. Pipe thread

V. Planning location of water service line

  A. Location criteria

    1. Concrete structure obstructions

    2. Turns and offsets

    3. Proximity to other service installations

IV. Water supply pipe location and installation

  A. Concealed installations

    1. Tub and shower fixtures

    2. Risers in concealed wall cavities

  B. Riser installation at fixture locations

  C. Cold water pipe installations

    1. Main

    2. Branch

  D. Hot water pipe installations

    1. Main

    2. Branch

  E. Sill cocks

  F. Drainage slope considerations

VII. Testing

  A. Air test

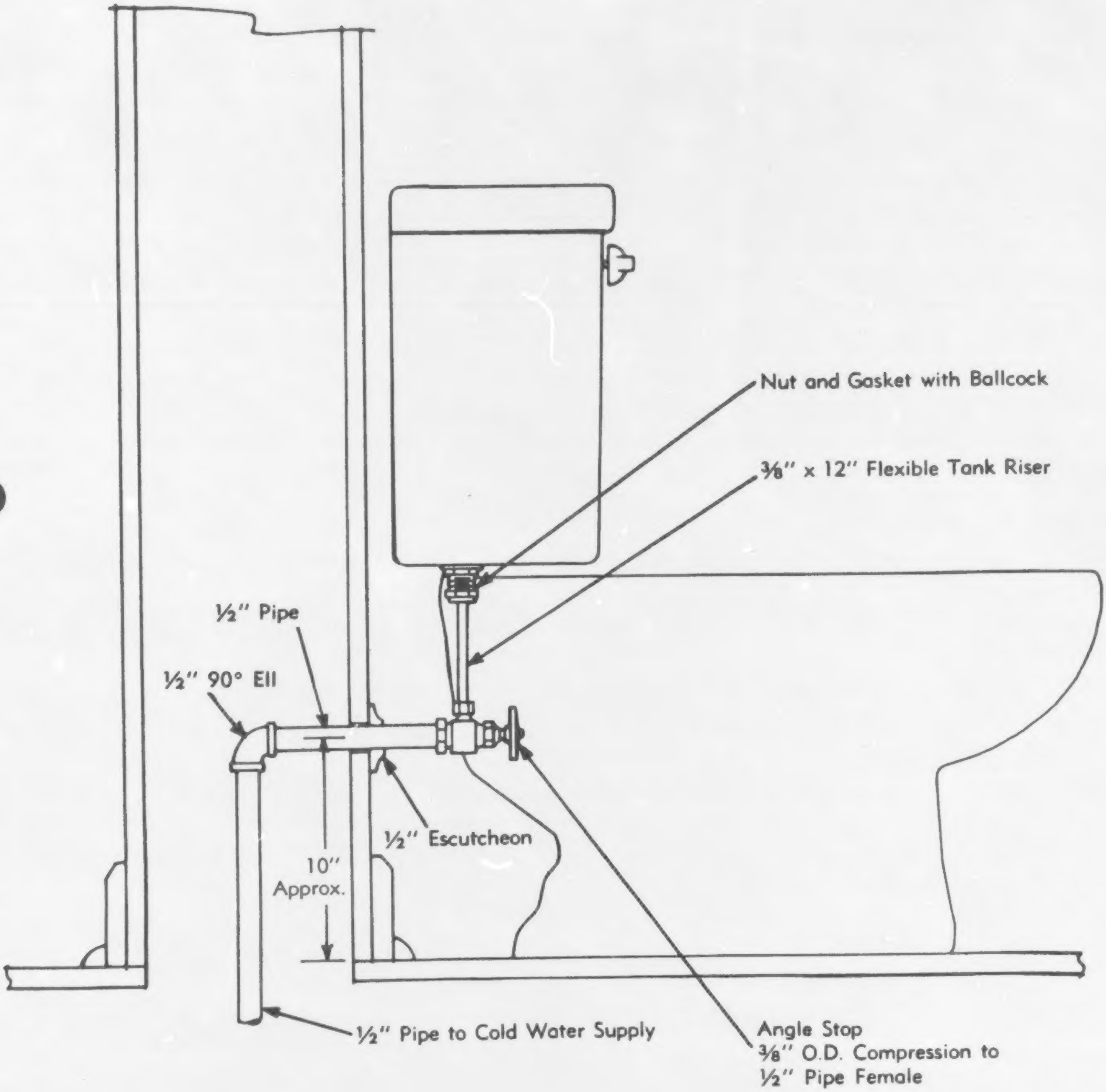
    1. Pressure (1 1/2 times working pressure or 150 lbs. psi)

    2. Test period (12 to 24 hrs.)

    3. Sealing method

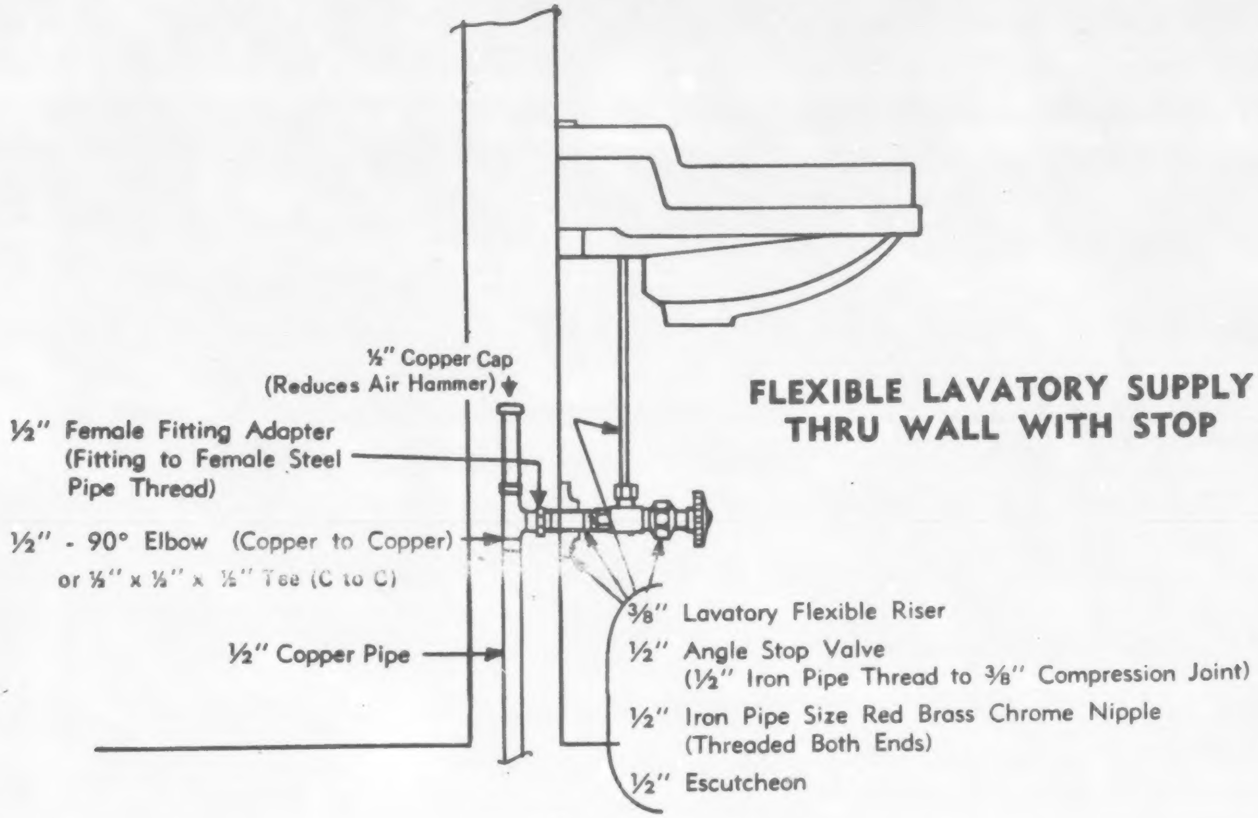
  B. Hydrostatic test

# TYPICAL WATER CLOSET SUPPLY

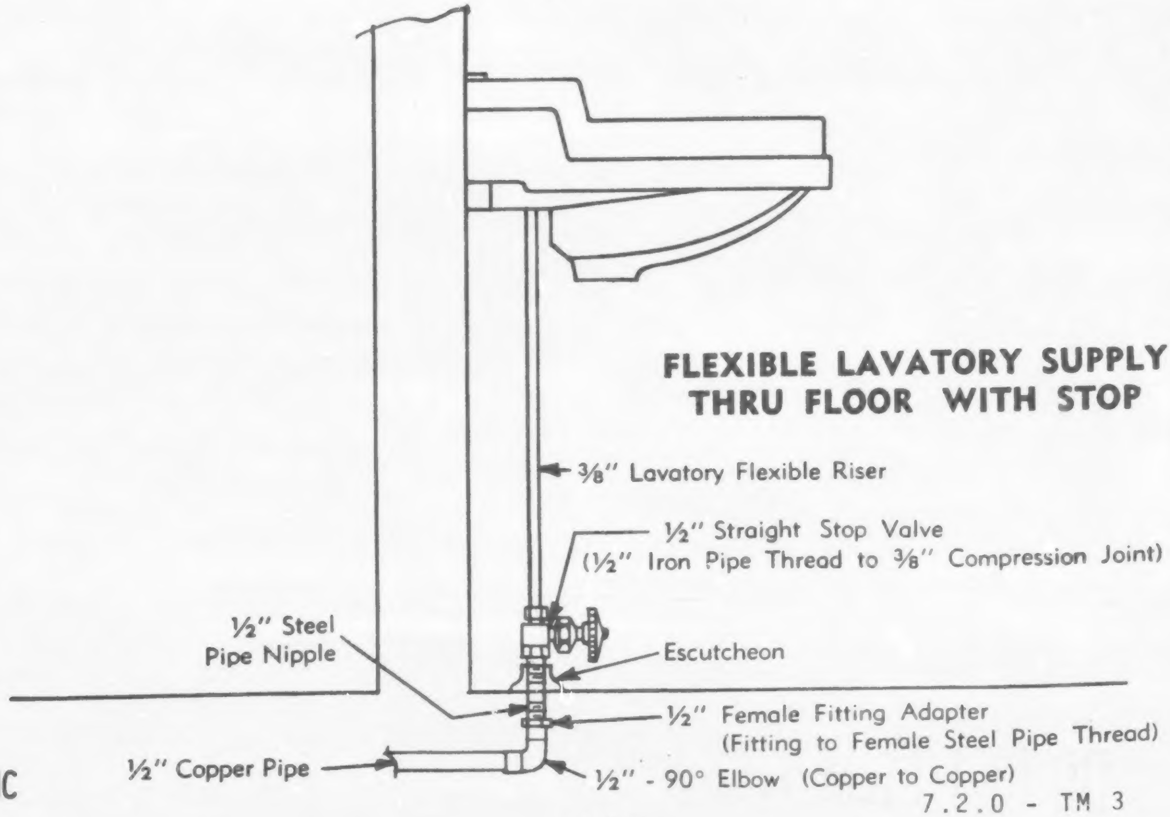


WATER SUPPLY TO WATER CLOSET

# TYPICAL LAVATORY SUPPLY

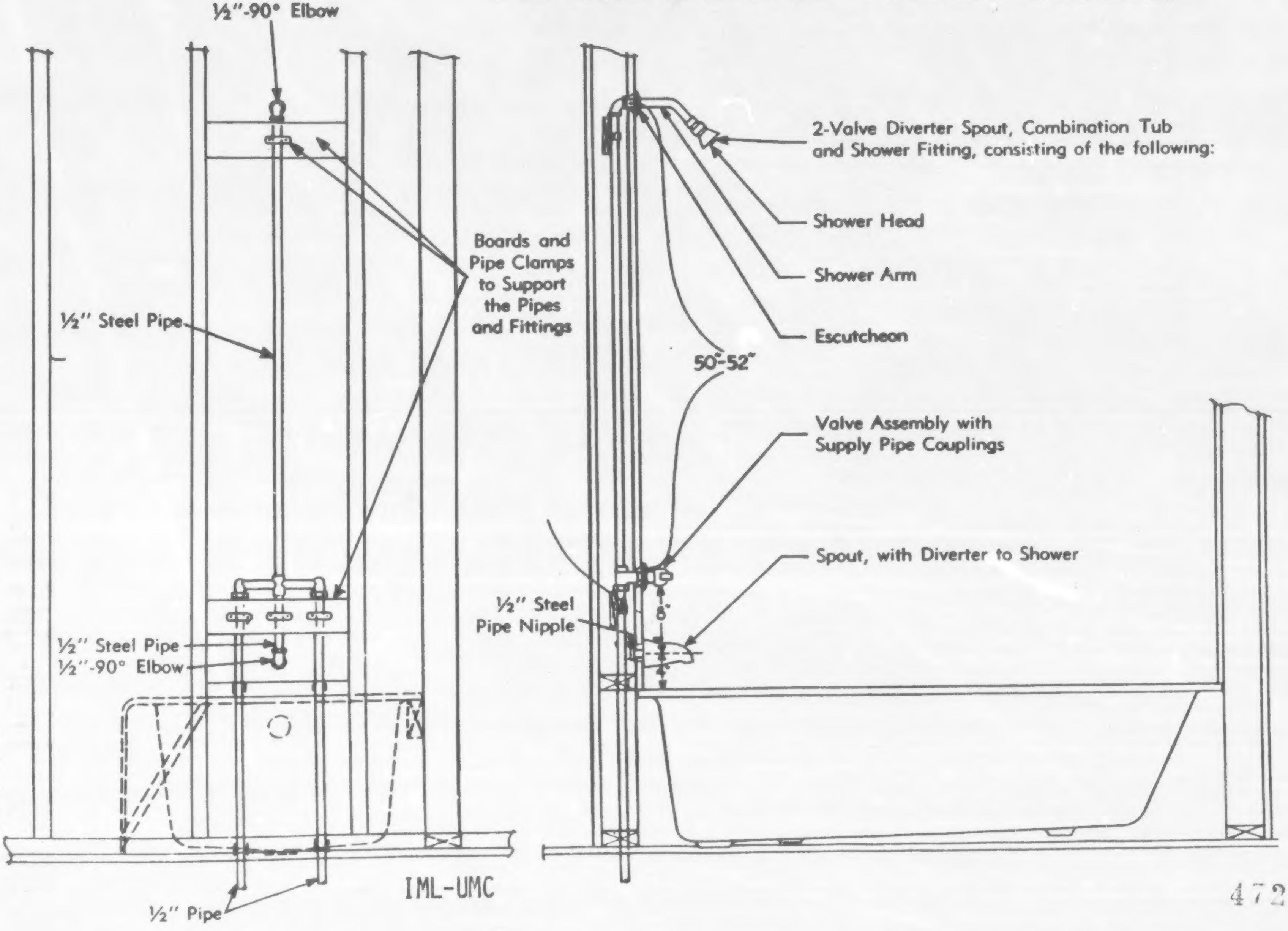

½" Copper Cap
(Reduces Air Hammer)
½" Female Fitting Adapter
(Fitting to Female Steel
Pipe Thread)
½" - 90° Elbow (Copper to Copper)
or ½" x ½" x ½" Tee (C to C)
½" Copper Pipe
⅜" Lavatory Flexible Riser
½" Angle Stop Valve
(½" Iron Pipe Thread to ⅜" Compression Joint)
½" Iron Pipe Size Red Brass Chrome Nipple
(Threaded Both Ends)
½" Escutcheon

## FLEXIBLE LAVATORY SUPPLY THRU WALL WITH STOP

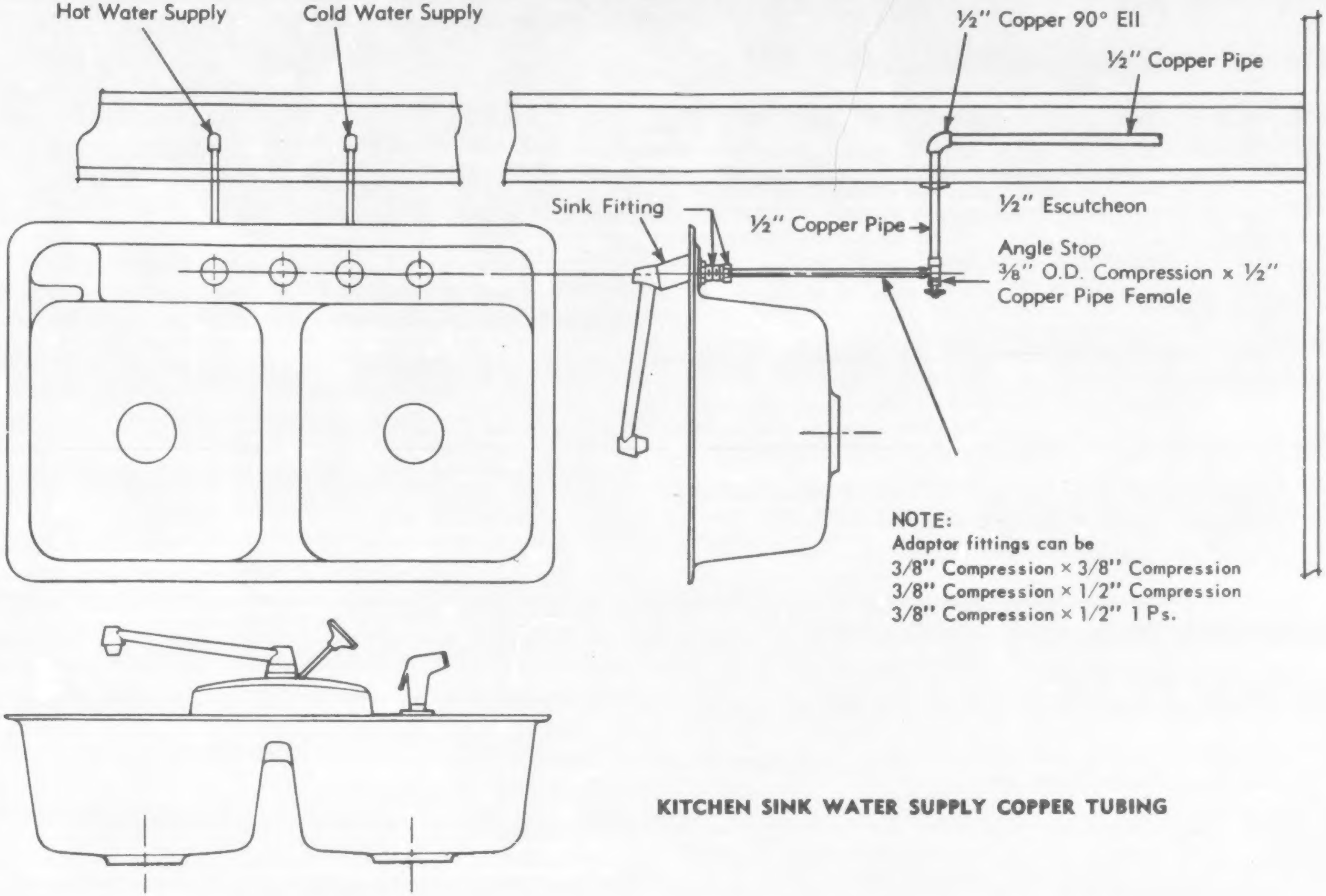

⅜" Lavatory Flexible Riser
½" Straight Stop Valve
(½" Iron Pipe Thread to ⅜" Compression Joint)
½" Steel
Pipe Nipple
Escutcheon
½" Female Fitting Adapter
(Fitting to Female Steel Pipe Thread)
½" Copper Pipe
½" - 90° Elbow (Copper to Copper)

## FLEXIBLE LAVATORY SUPPLY THRU FLOOR WITH STOP

# TYPICAL BATHTUB SUPPLY SYSTEM


½"-90° Elbow
Boards and Pipe Clamps to Support the Pipes and Fittings
½" Steel Pipe
½" Steel Pipe
½"-90° Elbow
½" Pipe
IML-UMC
2-Valve Diverter Spout, Combination Tub and Shower Fitting, consisting of the following:
Shower Head
Shower Arm
Escutcheon
50"-52"
Valve Assembly with Supply Pipe Couplings
Spout, with Diverter to Shower
½" Steel Pipe Nipple
8"
4"

# TYPICAL KITCHEN SINK SUPPLY



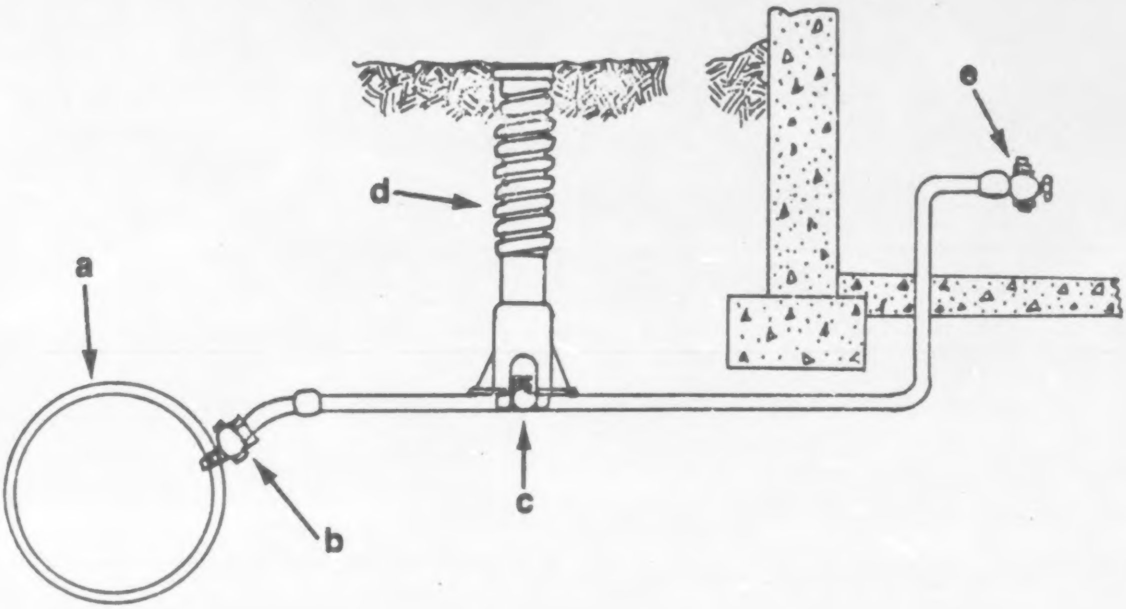
NOTE:
Adaptor fittings can be
3/8" Compression × 3/8" Compression
3/8" Compression × 1/2" Compression
3/8" Compression × 1/2" 1 Ps.

**KITCHEN SINK WATER SUPPLY COPPER TUBING**

# FRESH WATER DISTRIBUTION SYSTEM
## SECTION 7.2.0

## ASSIGNMENT SHEET #1 - MATERIAL IDENTIFICATION

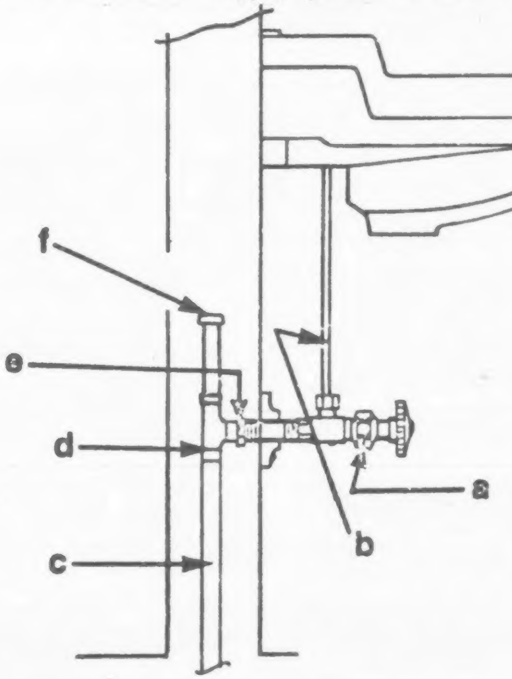
1. Name the house water service components:



a. ____________ b. ____________ c. ____________

d. ____________ e. ____________

2. Identify the water supply parts in the following figure:



a. ____________

b. ____________

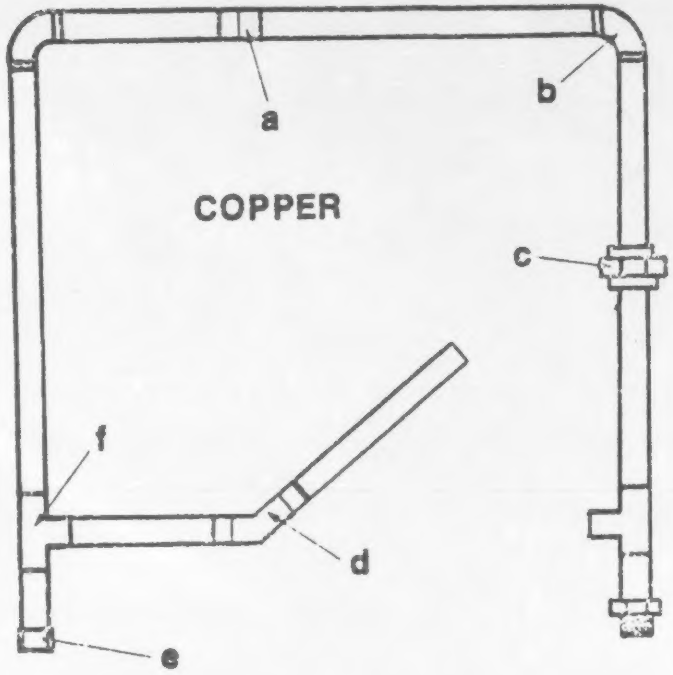
c. ____________

d. ____________

e. ____________

f. ____________

3. Name the parts of the copper pipe assembly illustrated below:



a. ______________________

b. ______________________

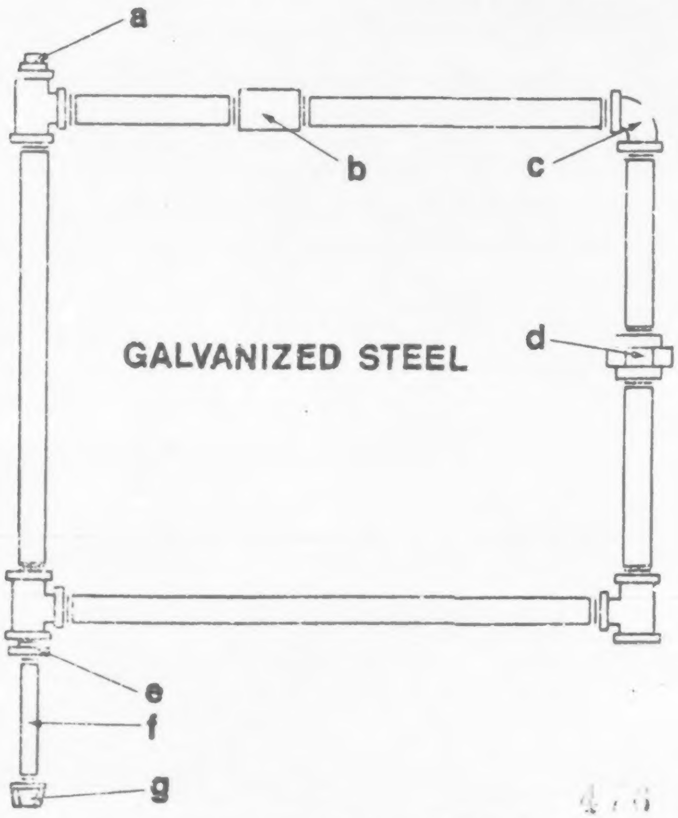
c. ______________________

d. ______________________

e. ______________________

f. ______________________

4. Name the parts of the galvanized steel pipe assembly illustradet below:



a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

f. ______________________

g. ______________________

## FRESH WATER DISTRIBUTION SYSTEM
## SECTION 7.2.0

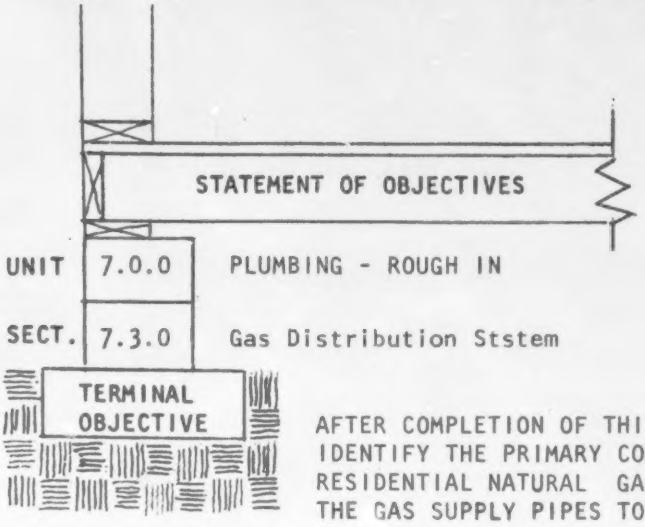
## ANSWERS TO ASSIGNMENT #1

1. a. Water main
   b. Tap
   c. Corporation cock
   d. Metal tube
   e, Shut-off valve

2. a. Angle stop valve
   b. Flexible viser
   c. 1/2" Copper pipe
   d. 1/2" Copper tee
   e. 1/2" Female fitting adapter
   f. 1/2" Copper cap

3. a. Coupling
   b. 90° Elbow
   c. Union
   d. 45° Elbow
   e. Cap
   f. Regular tee

4. a. Plug
   b. Coupling
   c. 90° Elbow
   d. Union
   e. Bushing
   f. Threaded pipe length
   g. Cap



## STATEMENT OF OBJECTIVES

UNIT 7.0.0 PLUMBING - ROUGH IN

SECT. 7.3.0 Gas Distribution Ststem

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL IDENTIFY THE PRIMARY COMPONENTS OF A SINGLE FAMILY RESIDENTIAL NATURAL GAS INSTALLATION, AND ROUGH IN THE GAS SUPPLY PIPES TO COMMONLY USED GAS CONSUMING UNITS.

## SPECIFIC OBJECTIVES

After completion of this section, the learner will:

7.3.1 Write the primary reason why natural gas is generally transported in black steel pipe rather than galvanized steel pipe and one reason for piping manufactured gas in copper pipe or tubing.

7.3.2 Layout, cut, assemble and install a one inch diameter gas pipe main and fittings suspended below the first floor. Begin the main outside the structure at the gas meter location and extend a sufficient distance to permit installation of branch lines and risers to each consuming fixture. Installation and piping shall be in accordance with local code or HUD Minimum Property Standards.

NOTE: SOME UTILITY COMPANIES REQUIRE AN INSIDE GAS METER INSTALLATION.

7.3.3 Layout, cut and install branch lines and risers, if necessary, to the furnace, water heater, clothes drier, kitchen range, outdoor cooking grill, gas lights, and refrigerator units when applicable. Install according to local codes or HUD Minimum Property Standards.

7.3.4 Cap each branch line in the general location of the consuming units and prepare the service end, usually outside the structure, with the necessary fittings to accommondate the gas meter installation. Observe local code or HUD Minimum Property Standards.

7.3.5 Contact utility company for meter installation specifications and gas service application and installation procedures.

NOTE: MOST UTILITY COMPANIES PROVIDE THE GAS SERVICE AND INSTALLATION AT MINIMAL OR NO CHARGE.

7.3.6 After gas service and meter installation, test all joints for possible leaks.

## INSTRUCTIONAL FORMAT

UNIT 7.0.0 PLUMBING - ROUGH IN

SECT. 7.3.0 Gas Distribution System

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local utility companies for supplemental information about the use and installation of gas services generally available to the residentail consumer.

III. Instructional materials included in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

   1. TM 1 - Typical Gas Piping Layout

D. Assignment sheet #1 - Gas Installation Terms and Definitions

E. Answers to assignment sheet #1

IV. References:

A. McConnell, Charles. Plumbers and Pipe Fitters Library. 3rd., ed., Volume 2: Indianapolis, Indiana: Howard W. Sams and Company, Inc., 1977.

## GAS DISTRIBUTION SYSTEM
## SECTION 7.3.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Piping materials
  A. Natural gas
    1. Wrought-steel
    2. Wrought-iron
    3. Threaded copper and brass
    4. Corrosive gases
  B. Liquified petroleum (LP) gases
    1. Steel or wrought-iron
    2. Brass
    3. Copper
    4. Seamless tubing
      a. Copper
      b. Brass
      c. Steel
      d. Aluminum

II. Piping specifications
  A. Minimum working pressure (125 psi)
  B. Cooper tubing
    1. Type or grade (K or L)
    2. Minimum wall thickness (.032")
  C. Aluminum tubing restrictions

1. Exterior locations

2. Direct contact material limitations

a. Masonry

b. Plaster walls

c. Insulation

D. Pipe thread specifications

III. Installation specifications and procedures

A. Branch connection positions

B. Drop branch connection to horizontal run

C. Pipe support spacing maximums

1. 3/8" to 1/2" - 6'

2. 3/4" to 1" - 8'

3. 1 1/4" and larger - 10'

4. 1 1/4" and larger (vertical) every floor level

D. Joist notching maximum

E. Slope considerations

F. Offsets

G. Concealed piping

1. Minimum size (1/2")

2. Fitting restrictions

3. Freezing problems

H. Electrical grounding

I. Capping outlets

J. Shutoff valves

K. Regulator and vent outlets

L. Service connection stopcock

IV. Test methods

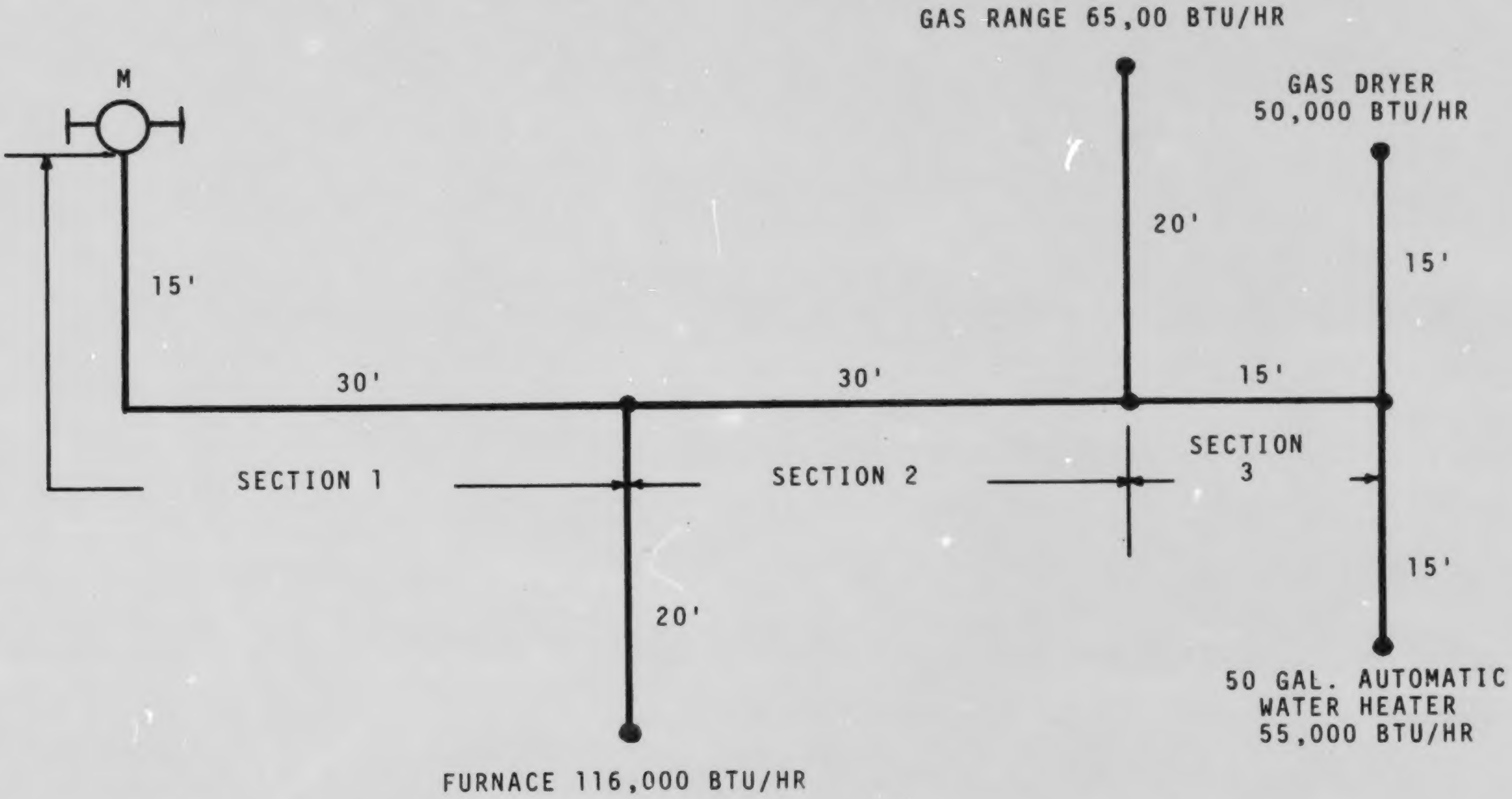
  A. Pressure test

    1. Minimums (6" of mercury or 3 lb. of gauge pressure for 10 minutes)

    2. Other tests

  B. Purging

# TYPICAL GAS-PIPING LAYOUT



# GAS DISTRIBUTION SYSTEM
## SECTION 7.3.0

## ASSIGNMENT SHEET #1 - GAS INSTALLATION TERMS AND DEFINITIONS

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

______1. A method of checking gas piping for leaks

______2. Shows proposed location of gas piping and sizes of various branches

______3. The quantity of heat required to raise the temperature of one pound of pure water one degree Fahrenheit

______4. Must be used to make turns in gas pipe

______5. The reason why some gases may not be transported in copper or brass pipes

______6. A short vertical pipe nipple and cap used to collect any condensate moisture that may collect in gas lines

______7. A vented device used to maintain constant gas pressure

______8. Removing gas from a section of piping

______9. A multipurpose device that can be useful for testing gas piping and measuring the gas pressure delivered to appliances in a building

______10. A liquid fuel made up principally of propane, butane or a mixture of both that returns to a gas at atmospheric pressure and specified temperatures

a. Fittings

b. Drip nipple

c. Soap and water solution

d. Purging

e. Piping layout

f. Corrosive action

g. Liquified petroleum gas

h. Gas regulator

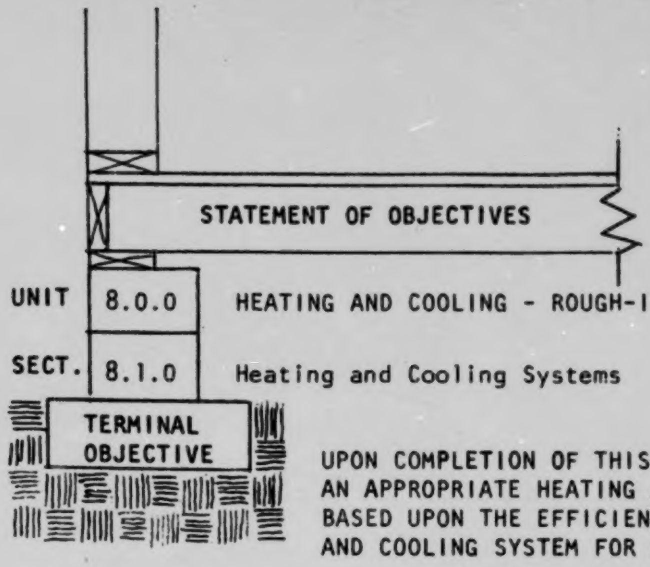
i. B.T.U.

j. Manometer

## GAS DISTRIBUTION SYSTEM
## SECTION 7.3.0

### ANSWERS TO ASSIGNMENT #1

1. c
2. e
3. i
4. a
5. f
6. b
7. h
8. d
9. j
10. g



## STATEMENT OF OBJECTIVES

UNIT 8.0.0 HEATING AND COOLING - ROUGH-IN

SECT. 8.1.0 Heating and Cooling Systems

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL SELECT AN APPROPRIATE HEATING AND COOLING SYSTEM FOR A RESIDENCE, BASED UPON THE EFFICIENCY AND RELIABILITY OF A HEATING AND COOLING SYSTEM FOR A PARTICULAR GEOGRAPHIC LOCATION.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

8.1.1 Write a definition of conduction, convection and radiation and apply one practical example of each heat transfer principle.

8.1.2 Identify three fuels that have been available in the recent past that produce heat for forced air furnace systems.

8.1.3 Sketch a plan view of three kinds of forced air heating systems. Label each.

8.1.4 Compare two basic types of forced hot water heating systems generally used for residential heating by explaining their primary water flow cycles.

8.1.5 Write five (5) kinds of electrical heating systems available for heating the residential structure and three (3) advantages and disadvantages of each.

8.1.6 Write a definition of compressor, condenser, expansion device and evaporator (cooling coil) as related to cooling systems designed for the residential structure.

8.1.7 Name three basic types of equipment used to cool residential structures. Sketch and lable a single diagram explaining how each functions.

8.1.8 List two (2) types of distribution systems that may be used to cool residential structures.

## INSTRUCTIONAL FORMAT

**UNIT** 8.0.0 **HEATING AND COOLING ROUGH-IN**

**SECT.** 8.1.0 Heating and Cooling Systems

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

- A. Provide learner with statement of objectives sheet
- B. Discuss terminal and specific objectives
- C. Provide learner with instruction sheets for use with this section
- D. Explain evaluation procedures

II. Suggested instructional methods:

- A. Demonstration - to show manipulative operations at construction site
- B. Discussion - to encourage question and answer activities
- C. Team assignment - to enhance personal relationships in the work environment.
- D. Illustrated lecture - to introduce a lesson or focus attention
- E. Field trips - to illustrate construction techniques and application of materials
- F. Consultant - representatives of local supply firms, utility companies and heating and cooling contractors for supplemental information about heating and cooling systems.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Forced Air Heating Systems
    - 2. TM 2 - Hot Water Heating Systems
- D. Assignment sheet #1 - Definitions and Terms
- E. Answers to assignment sheet #1

IV. References:

- A. Kicklighter, Clois E. Architecture Residential Drawing and Design. South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.
- B. Spence, William P. Architecture Design, Engineering, Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

## HEATING AND COOLING SYSTEMS
## SECTION 8.1.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Heat transfer principles
    A. Conduction
    B. Convection
    C. Radiation

II. Furnace fuels
    A. Natural gas
    B. Fuel oil
    C. LP gas
    D. Electricity

III. Kinds of forced air heating systems
    A. Upflow
    B. Downflow
    C. Horizontal

IV. Types of forced hot water heating systems
    A. Series loop
    B. One pipe
    C. Two pipe

V. Electric heating systems
    A. Concealed cable
        1. Advantages
            a. Completely hidden

        - b. Radiated heat
        - c. Individual room control
    - 2. Disadvantages
        - a. Slow response
        - b. Plaster coating
        - c. Repair problem
        - d. Remodeling obstructions
        - e. No provisions for humidification
- B. Baseboard panels
    - 1. Advantages
        - a. Even heat distribution (convection and radiation)
        - b. Ease of installation
        - c. Individual room control
    - 2. Disadvantages
        - a. No provision for humidification
        - b. Window drapery problem
        - C. Dust collectors
- C. Recessed heaters
    - 1. Advantages
        - a. Somewhat more effective and efficient
        - b. Uses little or no floor space in rooms
        - c. Usually less noticeable
    - 2. Disadvantages
        - a. Sometime fan driven
        - b. No provisions for humidification
        - c. Requires extra installation labor

D. Electric furnace
   1. Advantages
      a. Common heating and cooling ducts
      b. Provisions for humidification
      c. Provisions for air filtration
   2. Disadvantages
      a. Blower noise
      b. Usually single heat control
      c. Draft problem

E. Heat pump
   1. Advantages
      a. Combined heating and cooling
      b. Common ducts
      c. Provisions for humidification
   2. Disadvantages
      a. Efficiency drops below 30°F
      b. Draft problem
      c. Blower noise

F. Perimeter convectors
   1. Advantages
      a. Flexible floor location
      b. Separate unit
      c. Individual room control
   2. Disadvantages
      a. Collects lint
      b. No provisions for humidification
      c. Somewhat more expensive

VI. Cooling system major parts

  A. Compressor

    1. Function (compresses gas into high pressure)

    2. Position in cycle (draws gas from cooling side)

  B. Condenser

    1. Function (cools hot gases to liquid state)

    2. Position in ycle (receives hot gases from compressor)

  C. Evaporator (vaporizes refrigerant and absorbs heat)

  D. Expansion valve (reduces pressure from high side to low side of cycle)

VII. Basic types of cooling equipment for residential application

  A. Room air-conditioner (air cooled)

  B. Central with remote compressor and condenser

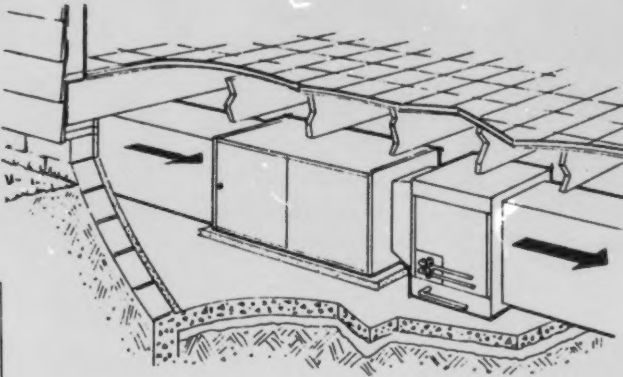
  C. Central with self contained components

VIII. Cool air distribution systems

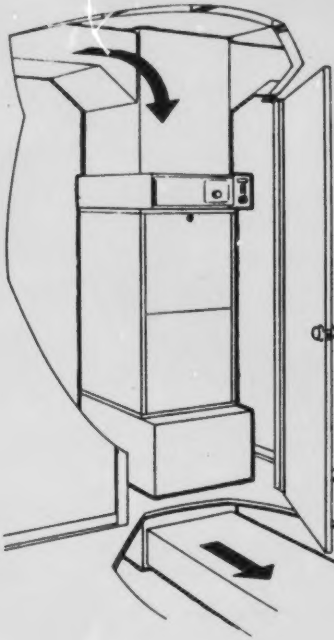
  A. Extended plenum

  B. Round pipe radial

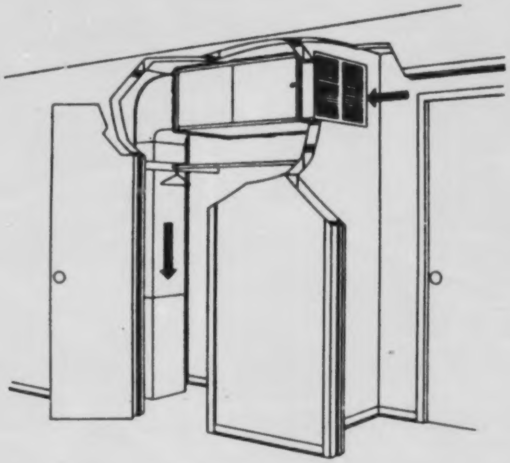
# FORCED AIR HEATING SYSTEMS



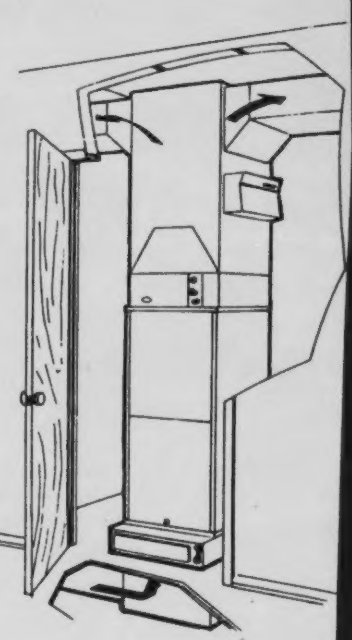
HORIZONTAL IN CRAWL SPACE



DOWN-FLO IN CLOSET



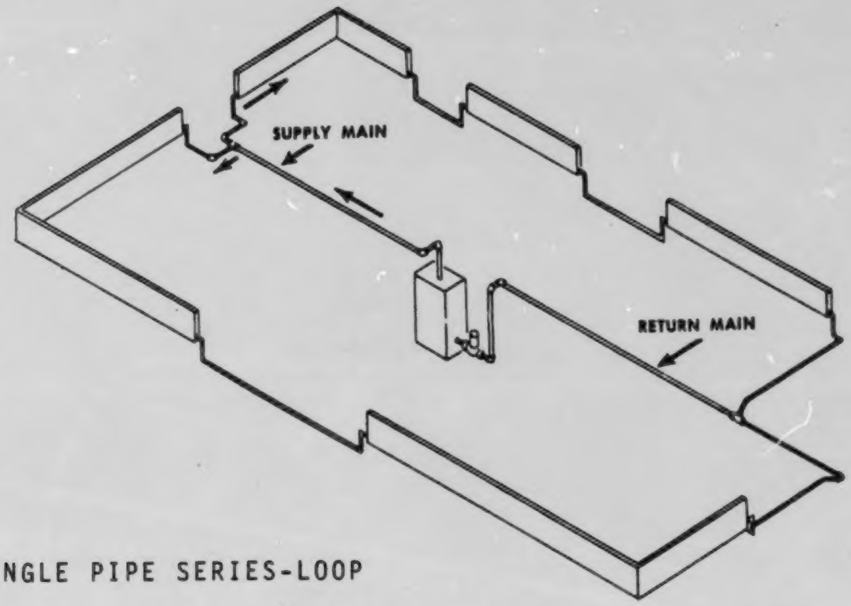
HORIZONTAL IN CLOSET



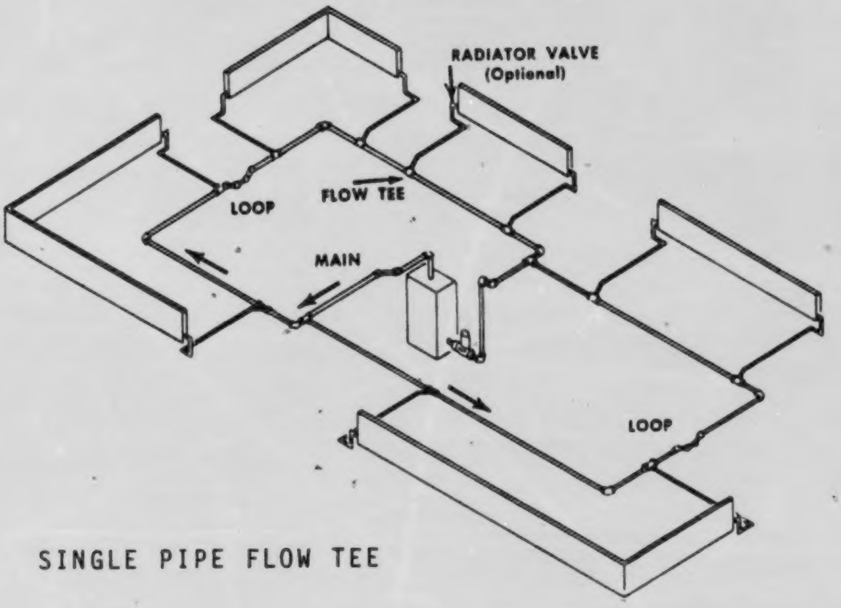
UP-FLO IN CLOSET

# HOT WATER HEATING SYSTEMS

(FORCED)



SINGLE PIPE SERIES-LOOP



SINGLE PIPE FLOW TEE

## HEATING AND COOLING SYSTEMS
## SECTION 8.1.0

### ASSIGNMENT SHEET #1 - DEFINITIONS AND TERMS

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

_____1. Transmission of heat from one molecule to another within a given material or form

_____2. Transfer of heat by a second agent, usually air

_____3. Transfer of heat by wave motion in about the same manner as light

_____4. A type of forced air heating in which supply air moves through a furnace from bottom to top

_____5. A type of forced air heating that forces heated air into ducts situated below floor level, usually in a basement house

_____6. A type of forced air furnace that may be hung below the floor of crawl space houses or in the attic of houses with concrete floors

_____7. A device which can both heat and cool a building

_____8. Part of a cooling system that raises the pressure of gas, usually freon.

_____9. Part of a cooling system that cools gases, usaually freon, to a liquid state

_____10. Part of a cooling system that absorbs heat

a. Radiation
b. Up-flow
c. Heat pump
d. Condenser
e. Horizontal
f. Evaporation
g. Convection
h. Compressor
i. Conduction
j. Down-flow

## HEATING AND COOLING SYSTEMS
## SECTION 8.1.0

### ANSWERS TO ASSIGNMENT #1

1. i
2. g
3. a
4. b
5. j
6. e
7. c
8. h
9. d
10. f

## STATEMENT OF OBJECTIVES

UNIT 8.0.0 HEATING AND COOLING - ROUGH-IN

SECT. 8.2.0 Installing Extended Plenum System - Counterflow

**TERMINAL OBJECTIVE**

AFTER COMPLETION OF THIS SECTION, THE LEARNER WILL ROUGH-IN PACKAGED COUNTERFLOW FOURCED AIR HEATING SYSTEM IN A SINGLE FAMILY ONE LEVEL RESIDENCE WHICH INCLUDES THE PLACEMENT OF BOTH RETURN AND WARM AIR PLENUMS, EXTENDED PLENUM, ROUND PIPE RUNS, RETURN AIR SYSTEM AND THERMOSTAT WIRE PLACEMENT.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

8.2.1 Submit architectural plans to local building supply companies and request an engineered heating and cooling layout including a cost figure for a packaged delivered price to the site.

8.2.2 Layout and cut holes for register boots in each room.

8.2.3 Install boots in each opening and attach in place temporarily.

8.2.4 Assemble pre-packaged warm air plenum and install directly under the location of the counterflow furnace.

NOTE: SOMETIMES GARAGE LOCATIONS HAVE PREVIOUSLY PREPARED WARM AIR PLENUMS CONSTRUCTION OF CONCRETE OR MASONRY BLOCKS LINED WITH A SPECIAL INSULATING MATERIAL.

8.2.5 Layout, cut and install a starting collar in the side or sides of the plenum to connect the rectangular ducts to the plenum.

8.2.6 Assemble snap lock type rectangular ducts.

8.2.7 Layout, cut and install take-offs in rectangular duct sections.

NOTE: TAKE-OFFS FORM THE CONNECTING PLACE FOR ROUND PIPE RUNS TO EACH ROOM.

8.2.8 Extend the plenum by connecting one rectangular duct to the starting collar and strapping to the underside of the floor joists.

8.2.9 Lock rectangular duct sections together using drive clips.

8.2.10 Continue installation of extended plenum sections with take offs installed until the farthest register boots may be conveniently reached.

8.2.11 Install end cap in the end of the last section of the extended plenum.

8.2.12 Assemble snap lock type round pipes used for supply air.

8.2.13 Install 90° adjustable elbows when needed in supply air pipes to individual rooms.

8.2.14 Install dampers in round supply air pipes nearest extended plenum.

8.2.15 Connect take offs at extended plenum to register boots located on or near exterior walls using round pipe sections.

8.2.16 Secure round pipe runs to floor joists with universal pipe hanger or galvanized fine wire.

8.2.17 Tape all joints in sheet metal connections using 2 inch wide duct tape.

8.2.18 Insulate pipe and extended plenum if crawl space perimeter is uninsulated.

8.2.19 Install return air system to furnace location using either an insulated round pipe attic system or a dropped hall ceiling return air system or a combination of both.

NOTE: A LOWERED HALL CEILING GENERALLY PERMITS EASY ACCESS TO ALL ROOMS FOR PLACEMENT OF RETURN AIR GRILLS OVER THE ENTRANCE DOOR TO EACH ROOM.

8.2.20 Establish thermostat location and install low voltage wiring from furnace location to thermostat location.

NOTE: CONTRARY TO MANY MANUFACTURER SUGGESTIONS, LOCATION OF THE THERMOSTAT SHOULD BE AT A HEIGHT OF 2 1/2 TO 4 FEET ABOVE THE FLOOR.

8.2.21 Locate and install a pre-fabricated fireplace by following detailed manufactures instructions.

## INSTRUCTIONAL FORMAT

UNIT 8.0.0 HEATING AND COOLING - ROUGH-IN

SECT. 8.2.0 Installing Extended Plenum System - Counterflow

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local heating and cooling supply firms, utility companies, and heating and cooling contractors.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  1. TM 1 - Extended Plenum Plan
  2. TM 2 - Round Pipe Plan
  3. TM 3 - Duct System Parts
  4. TM 4 - Independent Cooling System
  5. TM 5 - Mounting Cooling Coils
  6. TM 6 - Mounting Cooling Coils
  7. TM 7 - Package Cooling System
- D. Assignment sheet #1 - Counterflow Heating Installation
- E. Answers to assignment sheet #1

IV. References:

A. Kicklighter, Clois E. Architecture Residential Drawing and Design. South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.

B. Spence, William P. Architecture Design, Engineering, Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# INSTALLING EXTENDED PLENUM - COUNTERFLOW
## SECTION 8.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Basic forced air heating systems

A. Extended plenum

B. Round pipe

II. Heating and cooling plan

A Sources

1. Architect

2. Building supply company

3. Mail order companies

B. Reading a plan

1. Round pipe symbol

2. Rectangular duct symbol

3. Size representations

C. Typical installation plans for counterflow furnace

1. Extended plenum (see TM 1)

2. Round pipe (see TM 2)

III. General procedures

A. Duct system parts (see TM 3)

A-1 90° Angle boot

A-2 Straight boot with 45° angle

B. Center end boot

C. Center end boot with 45° angle

D-1 Straight boot with floor pan

E-1 Floor or ceiling outlet pan

- E-2 Ceiling outlet
- F. Shortway 90° elbow
- G. Longway 90° elbow
- H. End cap
- I. Stackhead
- J. Floor or ceiling outlet pan
- K. Stack reducer
- L. Flex elbow
- M. Top takeoff
- N. Side takeoff
- Q. Flat takeoff
- R. Starting collar
- S. Offset takeoff collar

B. Methods of making wall and floor openings
  1. Making templates
  2. Selection of floor or ceiling openings
  3. Selection of wall openings
  4. Cutting floor openings

C. Making openings in sheet metal

D. Cutting and assembling round pipe
  1. Shaping nested pipe
  2. Shortening pipe sections
  3. Joining pipe sections

E. Cutting and assembling duct
  1. Forming rectangular duct
  2. Shorting a section

        3. Joining pipe sections
            a. Connectors
            b. Drive clips
            c. Increaser adapter
        4. Joining wall stack

IV. Normal installation sequence

- A. Supply registers
    1. Location
    2. Types
- B. Return air grilles
- C. Furnace
    1. Base
    2. Ventilation
- D. Return-air runs
    1. Joist panning
    2. Stud spacing
    3. Types of return-air installations
        a. Raised floor in closet
        b. Utility room-wall grilles
        c. Dropped hall ceiling
        d. Insulated pipe in attic
- E. Supply air runs
    1. Wall stacks
    2. Supply plenum
    3. Insulation
- F. Smoke pipe

1. Offset limitations (75% of chimney height)

2. Manufacturers instructions

G. Fuel supply and controls

H. Pre-fabricated chimney

V. Air conditioning

A. General principles

1. Cooling coil (evaporation)

2. Condenser

3. Compressor

4. Refrigerant tubing

B. Split systems

C. Package systems

VI. Cooling distribution principles

A. Volumn of air

B. Return air source

1. Heating

2. Cooling

C. Natural movement of heated air

VII. Installation of cooling system in a ducted heating system

A. Cooling coil types

1. A

2. Slope

3. Flat

B. Furnace types and cooling coils recommended

1. Upflow (A)

2. Horizontal (Flat or slope)

        3. Counterflow (A or slope)

    C. Coil cabinets

    D. Condensate drains and pumps

    E. Remote condenser

        1. Location

        2. Types

            a. Horizontal discharge

            b. Vertical discharge

    F. Refrigerant tubing

        1. Precharged

        2. Job assembled

    G. Ductwork insulation

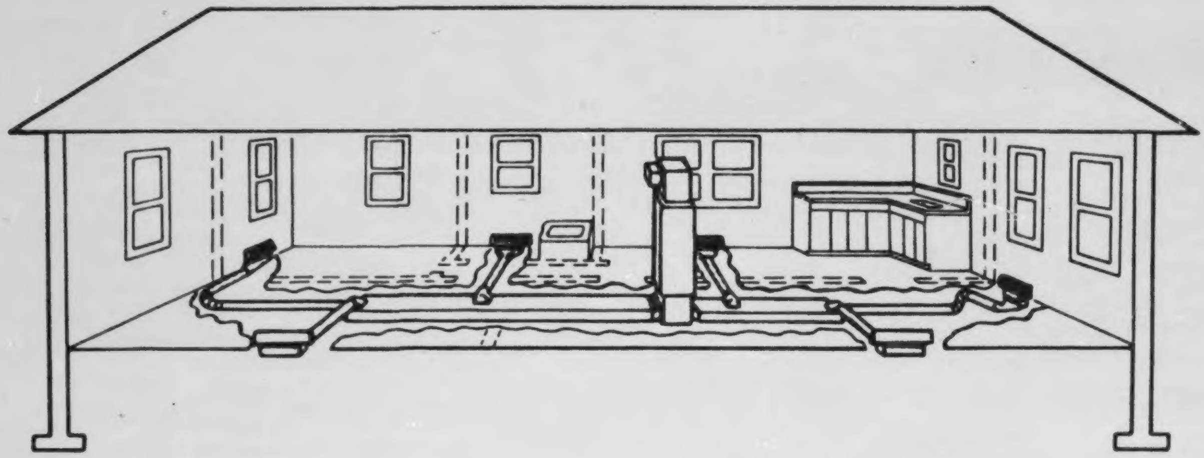
VIII. Independent air conditioning systems

    A. Blower coil (split system) in attic

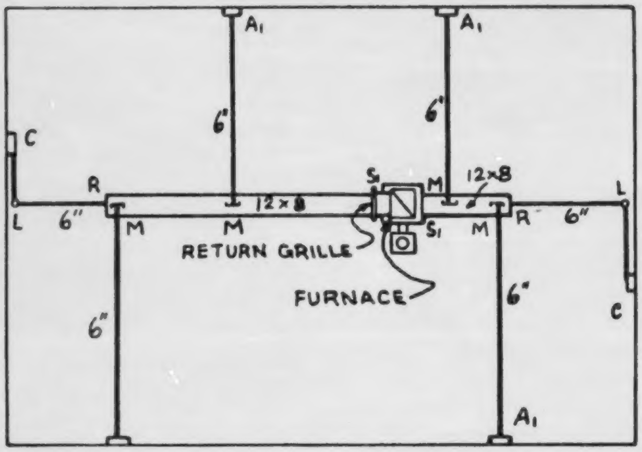
    B. Package unit (roof installation)

# EXTENDED PLENUM PLAN

(COUNTERFLOW FURNACE)



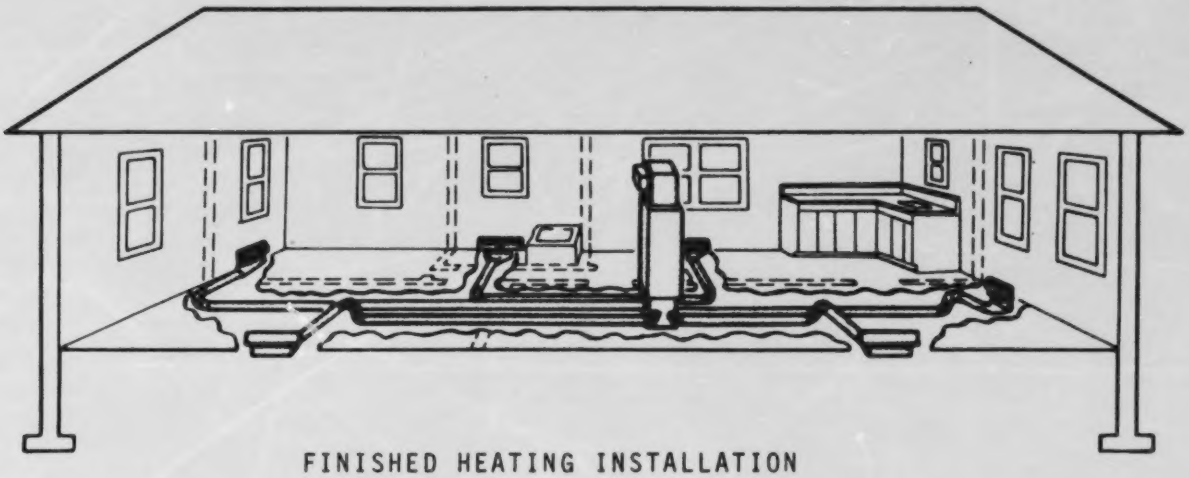
FINISHED HEATING INSTALLATION



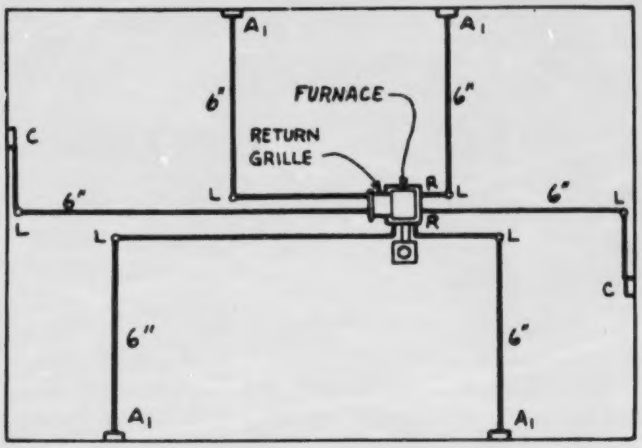
PLAN VIEW

# ROUND PIPE PLAN

(COUNTERFLOW FURNACE)

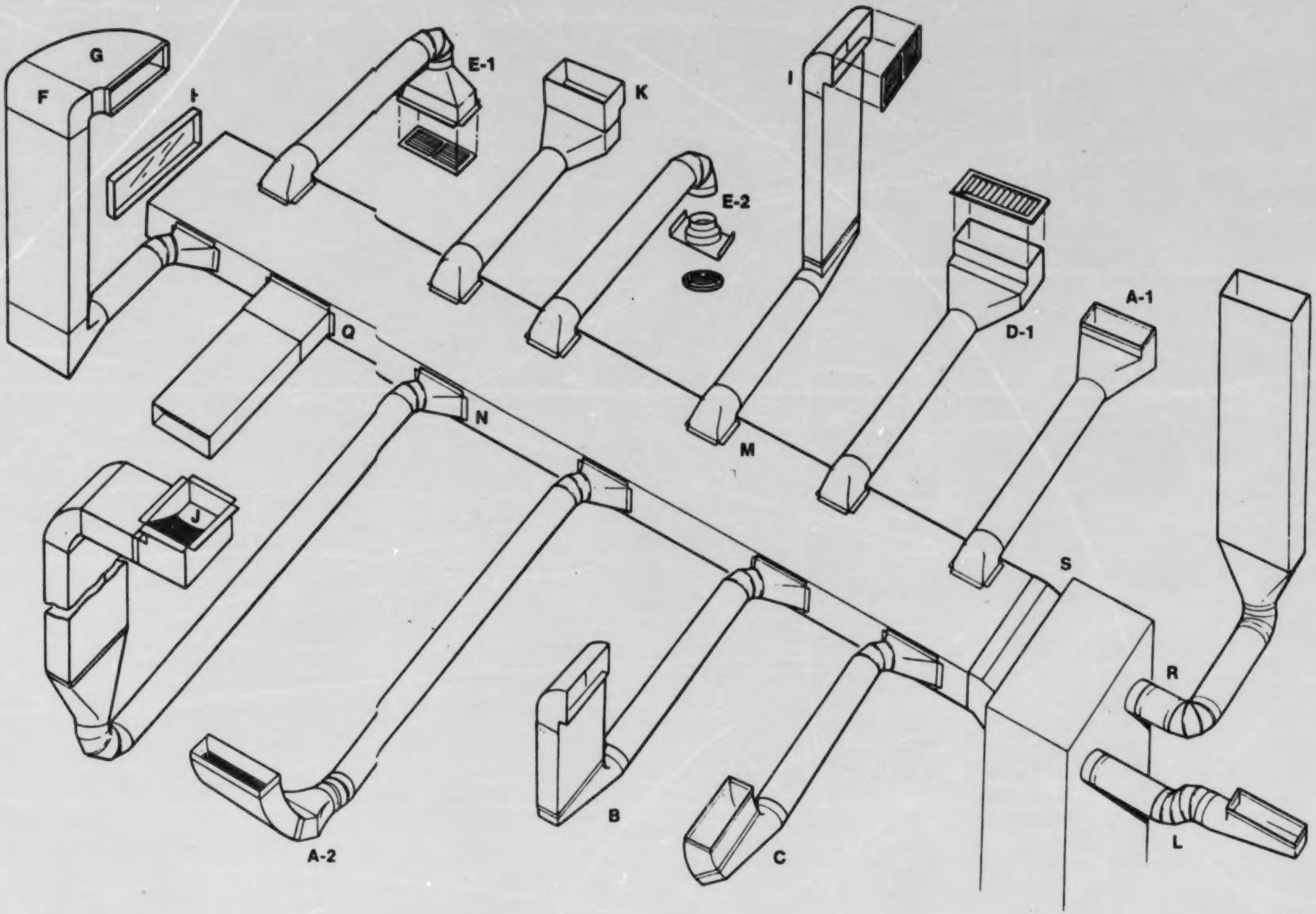


FINISHED HEATING INSTALLATION



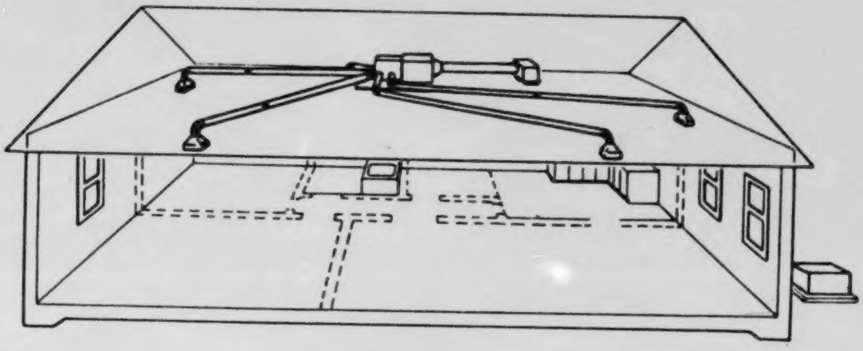
PLAN VIEW

# DUCT SYSTEM PARTS



8.2.0 - TM 3

# INDEPENDENT COOLING SYSTEM



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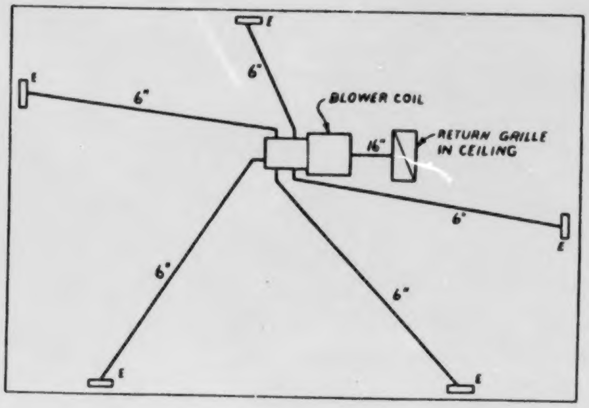
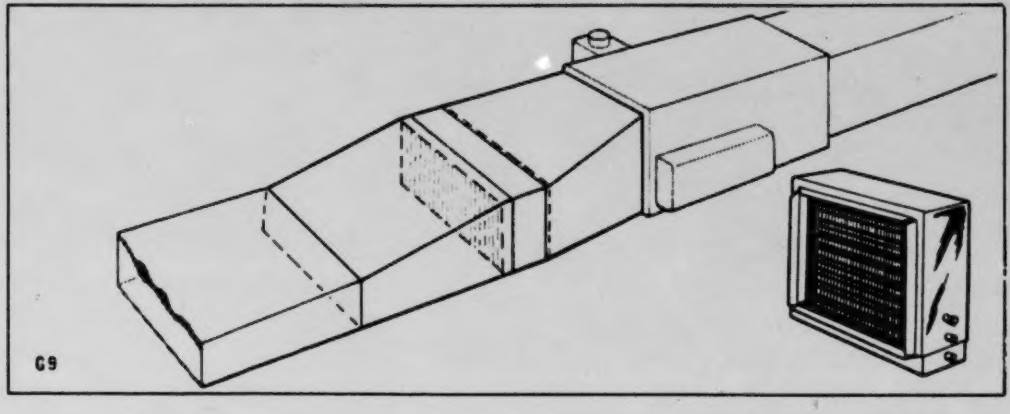


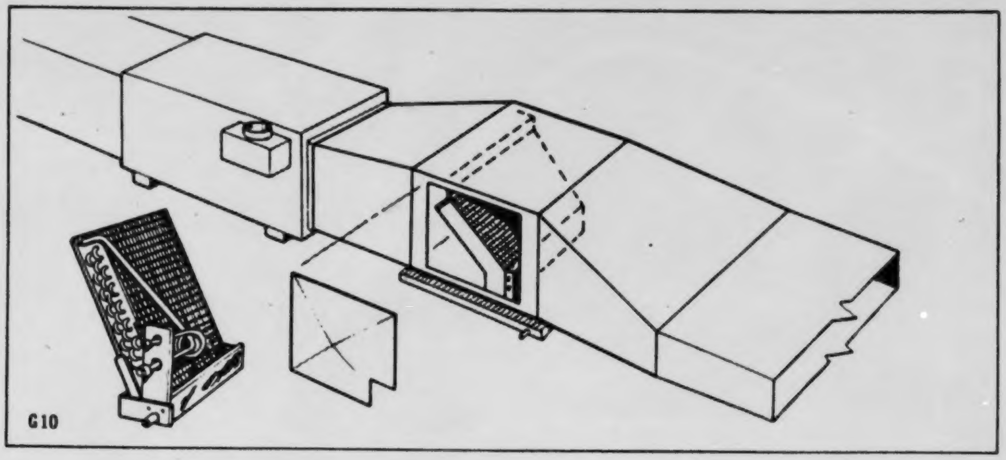
PLAN VIEW

# MOUNTING COOLING COILS



G9

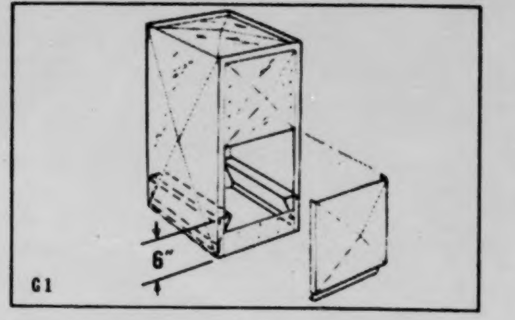
HORIZONTAL FURNACE
FLAT COIL



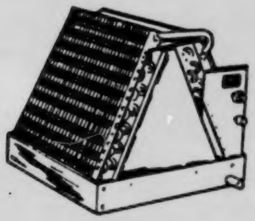
G10

HORIZONTAL FURNACE
SLOPE COIL

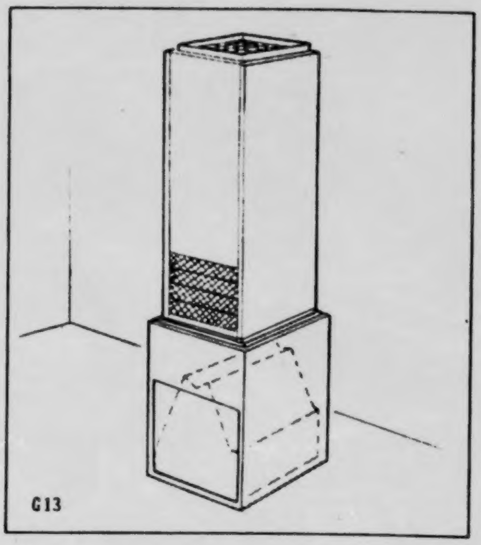
# MOUNTING COOLING COILS



UPFLOW FURNACE
(A) COIL

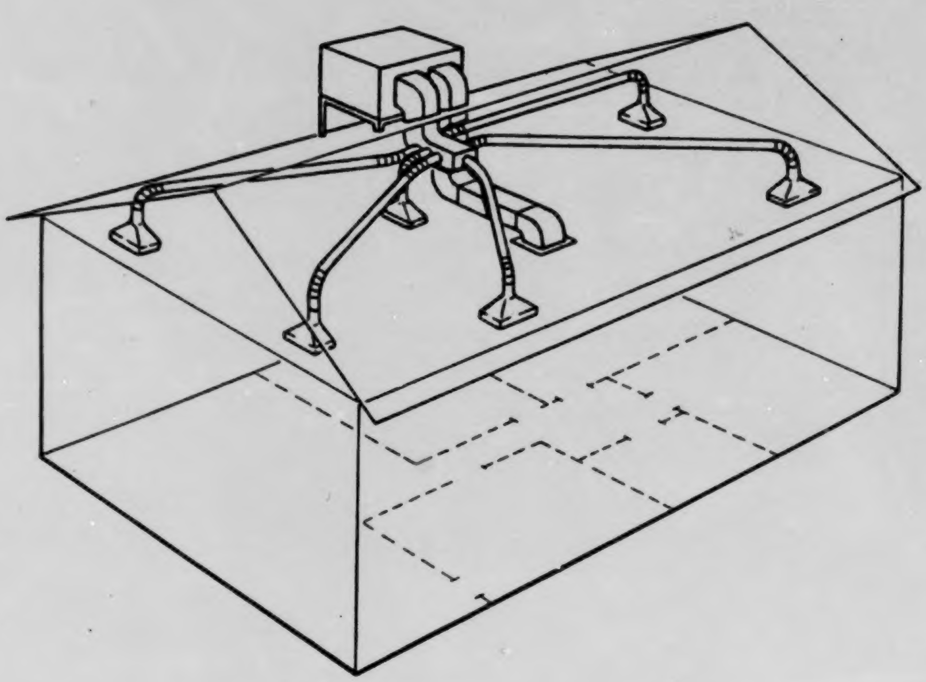


(A) COOLING COIL

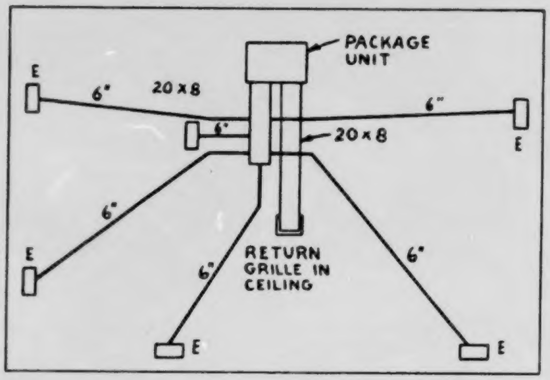


COUNTER FLOW FURNACE
(A) COIL

# PACKAGE COOLING SYSTEM



FINISHED COOLING INSTALLATION



PLAN VIEW

# INSTALLING EXTENDED PLENUM SYSTEM - COUNTERFLOW
## SECTION 8.2.0

## ASSIGNMENT #1 - MATERIAL ESTIMATING

Using the heating plan below, estimate the material needed to complete a forced air counterflow heating system.

____1. Number of 90° angle boots

____2. Number of center end boots with 45° angle

____3. Number of top takeoffs

____4. Number of starting collars

____5. Number of flex elbows

____6. Number of off set takeoff collars

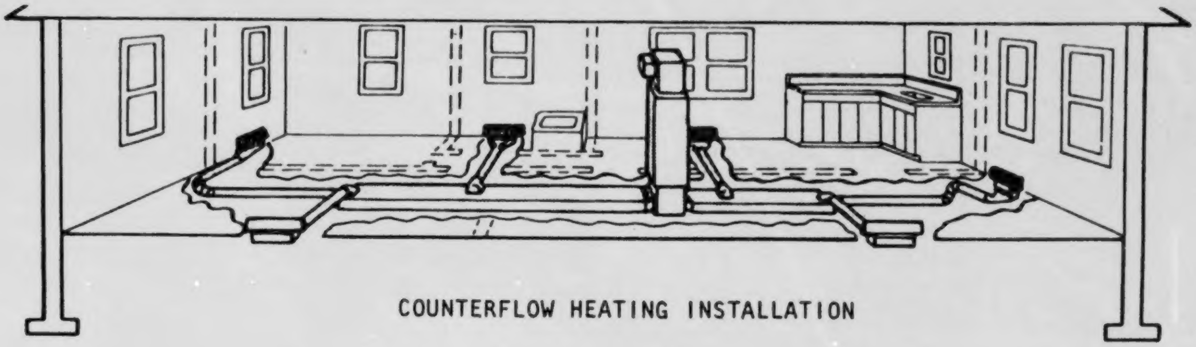
____7. Number of supply air plenums

____8. Number of return air grilles

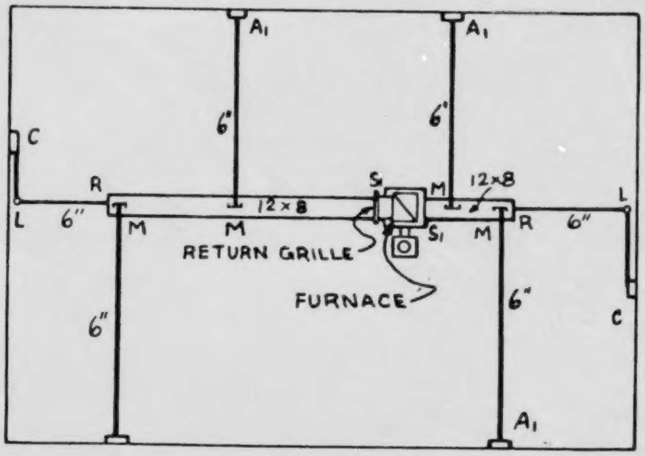
____9. Size of extended plenum

____10. Diameter of round supply pipe

____11. Number of baseboard diffusers



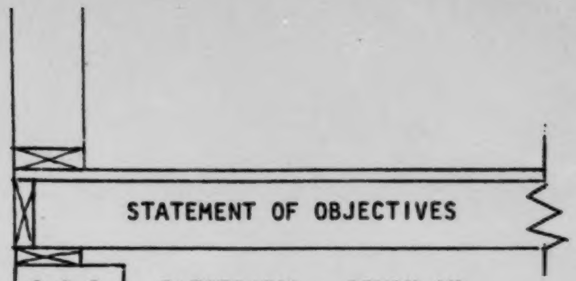
COUNTERFLOW HEATING INSTALLATION



## INSTALLING EXTENDED PLENUM SYSTEM - COUNTERFLOW
## SECTION 8.2.0

### ANSWERS TO ASSIGNMENT #1

1. 4
2. 2
3. 4
4. 2
5. 4
6. 2
7. 1
8. 1
9. 12 x 8"
10. 6"
11. 6"



## STATEMENT OF OBJECTIVES

**UNIT** 9.0.0 ELECTRICAL - ROUGH-IN

**SECT.** 9.1.0 Wiring the Interior

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL PLAN AND ROUGH-IN AN ELECTRICAL SYSTEM FOR A RESIDENTIAL STRUCTURE EXCLUSIVE OF THE SERVICE ENTRANCE. THE GENERAL TASKS INCLUDE INSTALLING THE MAIN DISTRIBUTION PANEL, ALL WALL AND CEILING OUTLET DEVICES, CIRCUIT CONDUCTORS (WIRES) AND LOW VOLTAGE CIRCUITS FOR OTHER COMMUNICATION DEVICES.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

9.1.1 Acquire a copy (booklet) of the local municipal electric code that prescribes installation specifications for residential structures.

> NOTE: CALL, WRITE OR VISIT YOUR LOCAL BUILDING INSPECTORS OFFICE FOR SERVICE.

9.1.2 Obtain a copy of the National Electric Code in the event local electric codes are non-existent or a copy of wiring specifications in HUD Minimum Property Standards.

9.1.3 Write a definition of the following special terms used in the electrical industry.

- ampacity
- ampere
- circuit
- circuit breaker
- conductors
- fuse
- ground
- ground fault
- ground-fault circuit interrupter (GFCI)
- grounding
- kilowatt-hour (Kwh)
- line conductor
- neutral
- outlet
- receptacle
- receptacle outlet
- resistance
- service disconnect
- service equipment
- short circuit
- switch
- volt
- voltage drop
- watt

9.1.4 Name three (3) kinds of electrical conductors generally used to transport electrical current within residential structures.

9.1.5 Write the current-carrying capacity (in amperes) for the following wire sizes with rubber or plastic insulation in conduit or cable: #14, 12, 10, 8, 6, 4, 2, 1, 2/0, and 4/0.

9.1.6 On an existing architectural plan, draw a complete electrical plan using electrical symbols.

9.1.7 Develop a complete materials list for all electrical rough-in needs. Submit to electrical supply firms for bids.

9.1.8 On top of the existing electrical plan, layout each branch circuit in color pencil.

NOTE: BE SURE TO OBSERVE THE NUMBER OF OUTLETS PER CIRCUIT AS SPECIFIED IN THE LOCAL/NATIONAL BUILDING CODE.

9.1.9 Locate and install the main distribution panel housing the disconnect (may be referred to as a power or load center) as specified by the local/national electric code.

9.1.10 Locate and install wall and ceiling outlet boxes for 120 volt, 20 amp. lighting circuits.

9.1.11 Locate and install wall outlet boxes for special appliance circuits of 120 volts that feed only one outlet box because of high wattage ratings.

9.1.12 Locate and install wall outlet boxes for single individual permanent appliances that consume 120 or 240 volts.

9.1.13 Locate and install recessed wall and ceiling electrical units (fans, etc.).

9.1.14 Install thin-wall conduit according to local/national electric code.

9.1.15 Bore holes for wire path and rough-in all branch circuit conductors.

NOTE: LABEL EACH CIRCUIT AT DISTRIBUTION PANEL.

9.1.16 Locate and rough-in low voltage circuit conductors for the doorbell and heating and cooling system controls.

9.1.17 Locate low voltage transformer for doorbell circuits.

9.1.18 Locate and rough-in conductors for television, telephone, and intercommunications systems.

INSTRUCTIONAL FORMAT

UNIT 9.0.0 ELECTRICAL - ROUGH-IN

SECT. 9.1.0 Wiring The Interior

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local electric utility companies, labor organizations, electrical building supply firms, electrical inspectors and electrical contractors.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Sizes and Types of Wire
  - 2. TM 2 - Single Pole Switch circuit
  - 3. TM 3 - Three Way Switch Circuit
  - 4. TM 4 - Range Plug and Receptacles
  - 5. TM 5 - Armored and Sheathed Cable
  - 6. TM 6 - Boxes and Fittings
  - 7. TM 7 - Service Entrance Panel
  - 8. TM 8 - Types of Conduit
- D. Assignment sheet #1 - Interior Wiring Terms and Definitions
- E. Answers to assignment sheet #1

IV. References:

A. Alrich, Walter N. *Electrical Construction Wiring.* Chicago, Illinois: American Technical Society, 1977.

B. Graham, Kenneth C. *Interior Electric Wiring*. 6th. ed., Chicago, Illinois: American Technical Society, 1961.

C. Miller, Rex. *Industrial Electricity*. Peoria, Illinois: Charles A. Bennett Company, Inc., 1978.

D. Mix, Floyd M. *House Wiring*. South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.

E. Rockis, Gary. *Residential Wiring*. Chicago, Illinois: American Technical Society, 1978.

## WIRING THE INTERIOR
## SECTION 9.1.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Electric codes

A. National Electric Code

B. City and State Codes

C. Utility company requirements

II. Electrical terms and meanings

A. Ampacity: Current carring capacity in amps

B. Ampere: Unit measuring rate of flow

C. Circuit: A complete electrical path

D. Circuit breaker: A safety device limiting maximum rate of current flow

E. Conductors: A material that readily permits electric current to flow through it

F. Fuse: A safety device used to limit the maximum rate of current flow

G. Ground: Side of electrical circuit or machine connected to the earth

H. Ground fault: Other than normal load current moving to ground

I. Ground fault circuit interrupter: Fast operating circuit breaker producing protection from very low levels of current leakage to ground

J. Grounding: Installing a device, usually wire, to connect an electrical system to the earth

K. Kilowatt-hour (Kwh): Unit by which electricity is metered (sold)

L. Line conductor: Power carrying wires (usually black or red)

M. Neutral: Ground wire that does not carry power, connected to the grounding system

N. Outlet: A point where current is drawn to supply a lighting fixture or appliance

O. Receptacle: A device placed in an outlet box to which wires are connected

P. Receptacle outlet: An outlet where one or more receptacles are installed

Q. Resistance: Measurement of the resistance to current flow

R. Service disconnect: Switch that disconnects current flow from the entire wiring system

S. Service equipment: The fittings and conductors that bring electricity into the building

T. Short circuit: Improper connection between current carrying wires or between a current carrying wire and a neutral

U. Switch: A device for breaking the flow of current

V. Volt: Unit used in measuring electrical pressure

W. Voltage drop: Loss of voltage (pressure) when wires are over loaded

X. Watt: Unit of measure of electrical power being used by a device

III. Kinds of electrical conductors

A. Nonmetallic sheathed cable

B. Flexible armored cable

C. Single wire conductor

IV. Current carrying capacity of rubber or plastic insulated wire in conduit or cable

A. Wire sizes and amperage capacity (copper wire)

1. #14 - 15 amps

2. #12 - 20 amps

3. #10 - 25 amps

4. #8 - 35 amps
5. #6 - 50 amps
6. #4 - 70 amps
7. #2 - 90 amps
8. #1 - 100 amps
9. #2/0 - 150 amps
10. #4/0 - 225 amps

V. Switches and receptacles

  A. Switch types
    1. Single pole
    2. Double pole
    3. Three-way
    4. Four-way

  B. Switch circuits
    1. Single pole
    2. Three-way

  C. Receptables (convenience outlets)
    1. Amperage and voltage ratings (15-60)
    2. Blade types
      a. Straight
      b. Locking
    3. Common types
      a. Duplex
      b. Single
      c. Fuse/receptacle combination

        d. Weatherproof
        e. 120/240 volt types
        f. Special 240 volt for air conditioners

    D. Receptacle parts and coded information
        1. Silver colored binding screws
        2. Underwriters labatory listing
        3. Grounding slot
        4. Canadian standards association
        5. Breakaway tab
        6. Bronze colored screws
        7. Green colored screw
        8. Smaller slot (hot)
        9. Long slot (neutral)
        10. Break off tab

VI. Wiring with nonmetallic sheathed cable
    A. Description
    B. Information printed on cable
        1. Size and number of cables
        2. Characteristics
            a. Flame retardent and moisture resistance (NM&NMC)
            b. Corrosion and fungus resistance (NMC)
            c. Separate grounding conductor (WITH GR)
    C. Roughing-in nonmetallic cable
        1. Outlet boxes
            a. Octagonal
            b. Square with extensions rings

c. Rectangular

d. Multiple installations (garg.)

e. Bar hangers

2. Drilling holes

a. Bits

b. Power drilling equipment

3. Installing cable runs

a. Pulling

b. Stripping cable jacket

c. Routing wire

1. Through studs and joists

2. Around corners

3. Through masonry walls

D. Securing cables

1. Stapling

2. Support spacing (4 1/2')

3. Guard strips

4. Grounding methods

a. Component

b. Pigtail

c. Clip

5. Outlet box clamp types

a. Saddle

b. Straight

c. Cable connectors

E. Folding back wires

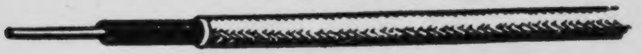
- VII. Load center (service panel)
  - A. Placement
  - B. Interior types
  - C. Overload protection
    - 1. Fusable
    - 2. Breaker
  - D. Capacity
- VIII. Recessed electrical units
  - A. Exhaust fans
  - B. Light fixtures
  - C. Medicine cabinets
  - D. Special recessed fixtures
- IX. Location criteria for wall and ceiling outlet boxes
  - A. Ceiling light outlets
  - B. Wall switch outlets
  - C. Wall receptacle outlets
    - 1. Room lighting
    - 2. Individual permanent appliances
- X. Wiring with conduit
  - A. Common types
    - 1. Electrical metallic tubing (EMT)
    - 2. Rigid conduit
    - 3. Flexible metal conduit
  - B. Installation of EMT
    - 1. Sizes (1/2 to 4" dia. x 10' lengths)

    2. Cutting methods
    3. Bending techniques
        a. 90° bends
        b. Offset bends
        c. Double offsets or saddles
        d. Straightening
    4. Bending rules
        a. Internal diameter requirements
        b. Minimum bends (4quarter bends between fitting and outlets)
        C. Minimum radius (see NEC)

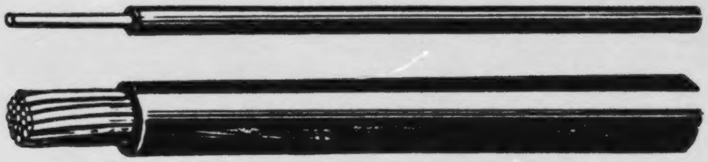
XI. Low voltage wiring

- A. Signaling systems
    - 1. Bell/buzzer
    - 2. Radio/intercom
- B. Security fire systems
- C. Remote control wiring
- D. Other communication systems
    - 1. Television cable
    - 2. Telephone systems

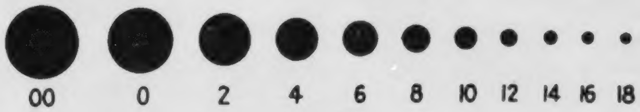
# SIZES AND TYPES OF WIRES



RUBBER-COVERED WIRE HAS RUBBER INSTEAD OF PLASTIC INSULATION. IT HAS A FABRIC OVERBRAID.



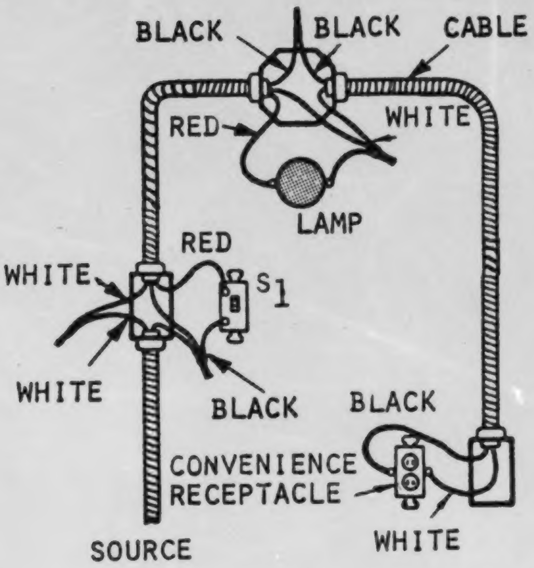
TYPE T WIRE IS THE MOST COMMON WIRE IN USE. IT IS USUALLY USED ONLY INDOORS BUT MAY BE USED OVERHEAD OUTDOORS, IN FREE AIR. IF IT IS NO. 8 OR HEAVIER, IT IS STRANDED.

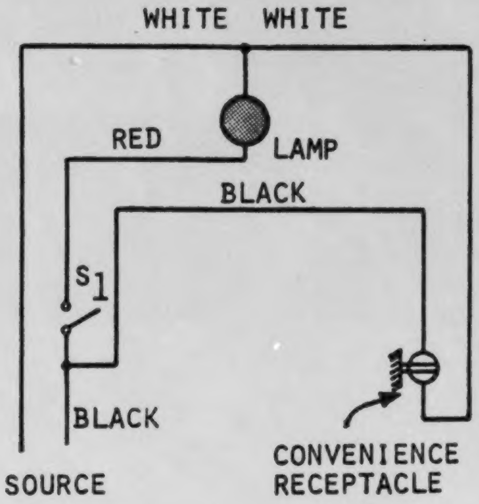


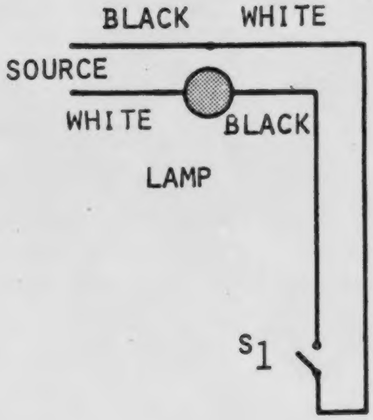
ACTUAL DIAMETERS OF DIFFERENT SIZES OF COPPER WIRE, WITHOUT THE INSULATION.

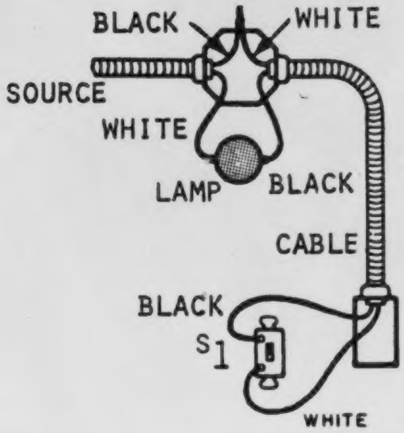
COURTESY OF:
TRW CRESCENT

# SINGLE POLE SWITCH CIRCUITS









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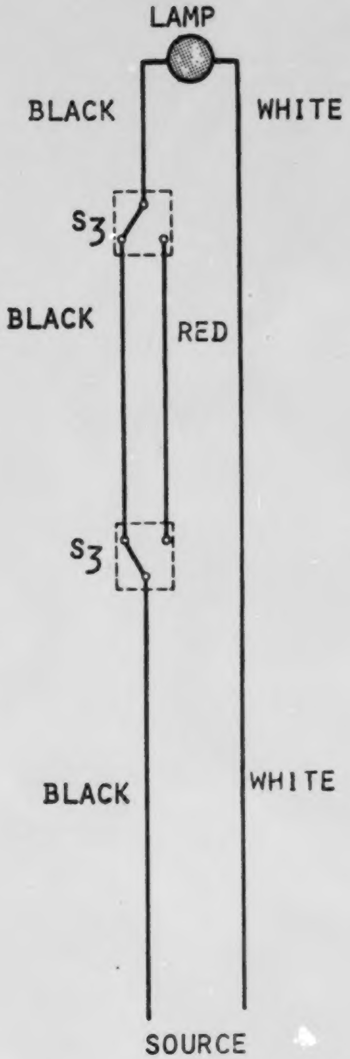
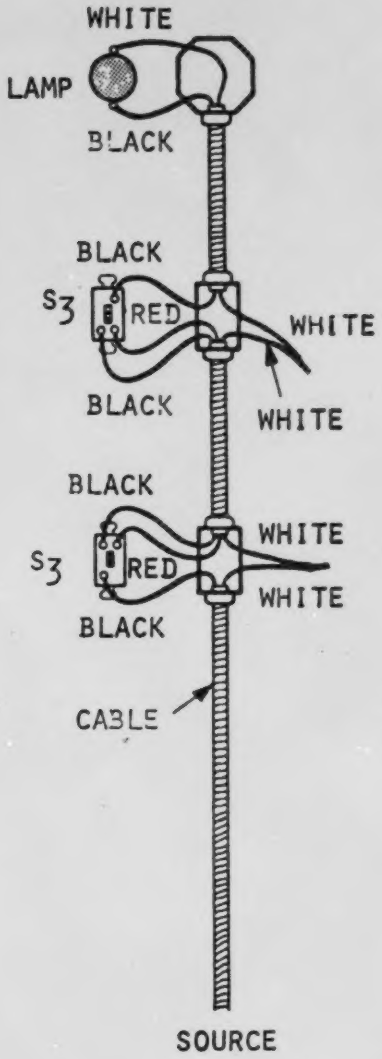
# THREE WAY SWITCH CIRCUIT





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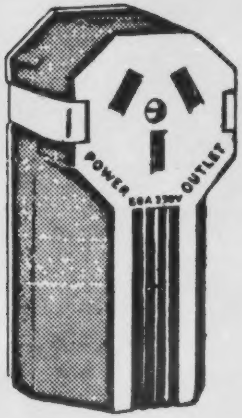
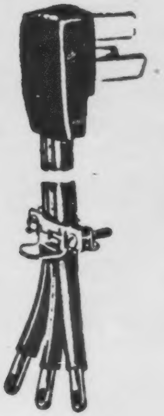
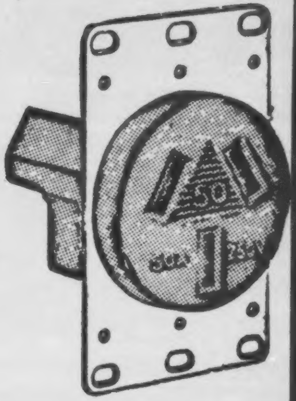
# RANGE PLUG & RECEPTACLES



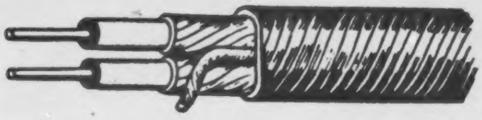




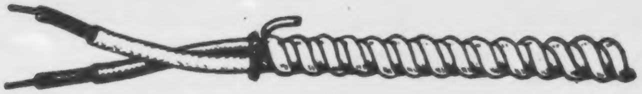
9.1.0 - TM 4

COURTESY OF
MCGRAW HILL BOOK CO.
PRACTICAL ELECTRICAL WIRING
BY H.P. RICHTER; 8TH EDITION
IML-UMC

# ARMORED AND SHEATHED CABLE



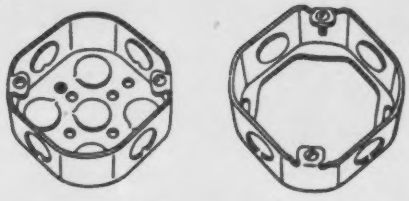
NONMETALLIC SHEATHED CABLE CONSISTS OF TWO OR THREE INDIVIDUAL TYPE T WIRES, ASSEMBLED INTO A CABLE. TYPE NM IS SHOWN, AND MAY BE USED ONLY IN DRY LOCATIONS. TYPE NMC MAY BE USED IN WET OR DRY LOCATIONS.



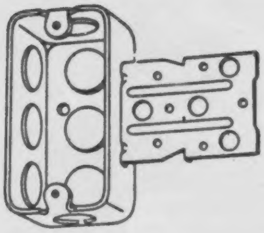
ARMORED CABLE CONSISTS OF TWO OR THREE INDIVIDUAL WIRES, ASSEMBLED INTO A CABLE, PROTECTED BY FLEXIBLE STEEL ARMOR. IT MAY BE USED ONLY INDOORS.

COURTESY OF:
TRW CRESCENT

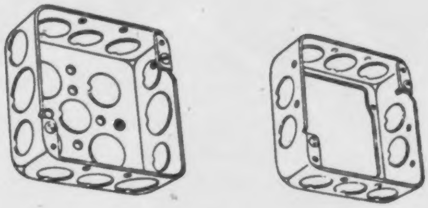
# BOXES & FITTINGS



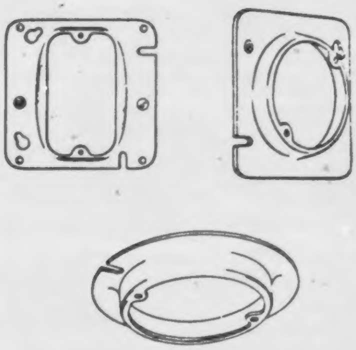
4" OCTAGON BOX &
EXTENSION RING



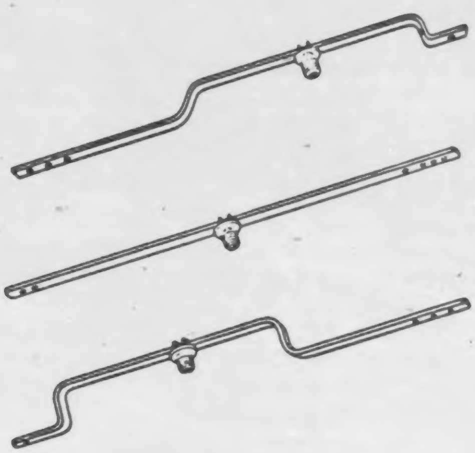
UTILITY OR SWITCH BOX
WITH MOUNTING BRACKET



4" SQUARE BOX &
EXTENSION RING



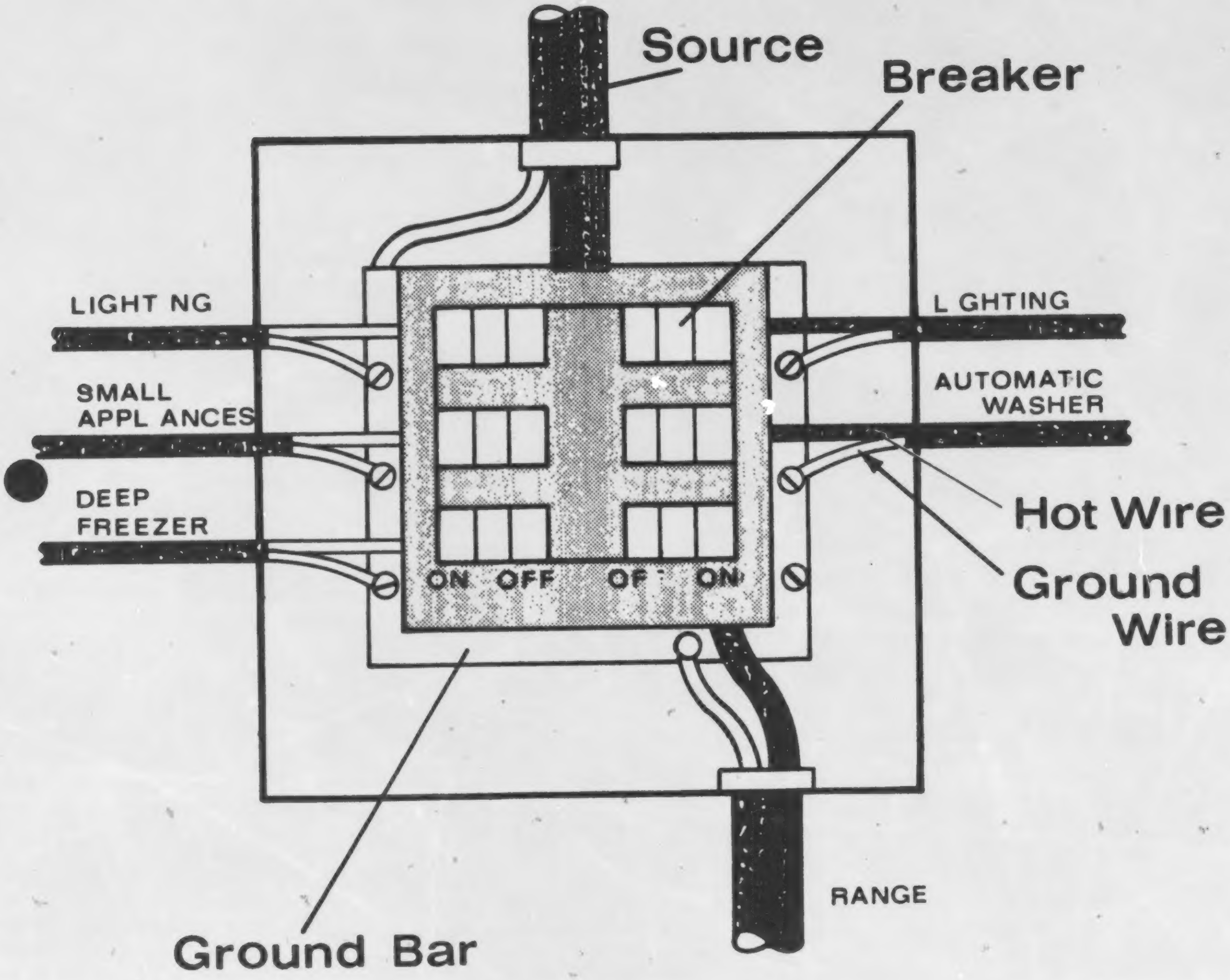
VARIOUS DESIGNS IN
PLASTER RINGS



BOX BAR HANGERS

COURTESY OF
CALIFORNIA STATE DEPT. OF ED.
ELECTRICAL WIRING PART 3
IML-UMC

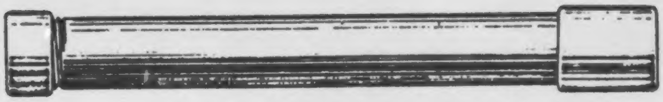
# SERVICE ENTRANCE PANEL



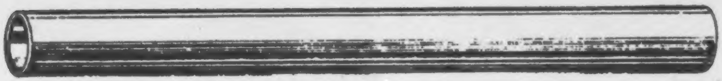
COURTESY OF:
CURRICULUM AND INSTRUCTIONAL MATERIALS CENTER
STATE DEPARTMENT OF VOCATIONAL-TECHNICAL EDUCATION
STILLWATER, OKLAHOMA

IML-UMC

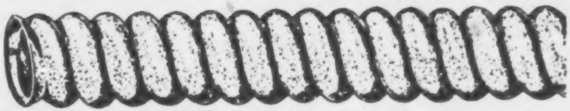
# TYPES OF CONDUITS



(A) RIGID CONDUIT



(B) ELECTRICAL METALLIC
TUBING (EMT)



(C) FLEXIBLE CONDUIT

COURTESY OF
MCGRAW HILL BOOK CO.
PRACTICAL ELECTRICAL WIRING
BY H.P. RICHTER;8TH EDITION
IML-UMC

# WIRING THE INTERIOR
## SECTION 9.1.0

## ASSIGNMENT SHEET #1 - INTERIOR WIRING TERMS AND DEFINITIONS

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

______1. Thin wall metal raceway of circular cross section with associated electrical couplings, connectors and fittings

______2. Wiring of less than 50 volts originating at a transformer

______3. Spiral metal raceway disigned for flexible installation with a circular cross section

______4. A factory assembly of two or more insulated conductors having an outer sheath of moisture-resistant, flame-retardant, nonmetallic material

______5. Sensitive personal protection current limiting device that opens the circuit when a very small amount of current leaks to ground

______6. Device used to open or transfer circuit direction

______7. Conductor that supplies electrical energy to a switch

______8. Conductor that carries electrical energy from the switch to the load

______9. Transfer conductors in a switching situation used between 3-way and 4-way switches

______10. Point of attachments for conductors

a. Low voltage circuits

b. Ground fault interrupter

c. Switch

d. Electrical metallic tubing

e. Switch leg

f. Traveler

g. Terminal

h. Flexible metal conduit

i. Return leg

j. Cable

## WIRING THE INTERIOR
## SECTION 9.1.0

## ANSWERS TO ASSIGNMENT #1

1. d
2. a
3. h
4. j
5. b
6. c
7. e
8. i
9. f
10. g

# STATEMENT OF OBJECTIVES

UNIT 9.0.0 ELECTRICAL - ROUGH-IN

SECT. 9.2.0 Wiring The Exterior

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL PLAN AND ROUGH-IN THE ELECTRICAL SERVICES ENTRANCE FOR A RESIDENTAL STRUCTURE, BOTH UNDERGROUND AND OVERHEAD. THE INSTALLATION OF OTHER EXTERIOR ELECTRICAL SERVICES WILL BE COMPLETED.

## SPECIAL OBJECTIVES

After completion of this section, the learner will:

9.2.1 Contact the local utility company and request the service installation specifications for a 100, 150 and 200 amp. underground and overhead electrical installation.

9.2.2 Locate and install a meter socket for the size electrical entrance planned. (Locate after exterior wall covering is applied if possible.)

NOTE: METER SOCKETS ARE GENERALLY PROVIDED BY THE UTILITY COMPANY.

9.2.3 Layout, cut and install entrance conduit and fittings to the top of the meter socket and extend above roof line by specified distance.

9.2.4 Install service entrance conductors through top of conduit and secure to top terminals in meter socket.

9.2.5 Connect bottom terminals of meter socket to conductor and extend to distribution panel.

9.2.6 Provide a service ground for the electrical system as specified by local/national electric code.

9.2.7 Connect entrance conductors to disconnect terminals at distribution panel.

9.2.8 Install ground-interrupter for all garage and exterior outlets.

9.2.9 Excavate and bury underground conductor for exterior yard lights or service to other locations.

9.2.10 Request service company to install service drops to activate electrical service to the main disconnect.

## INSTRUCTIONAL FORMAT

UNIT 9.0.0 ELECTRICAL - ROUGH-IN

SECT. 9.2.0 Wiring The Exterior

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local electric utility companies, labor organizations, electrical building supply firms, electrical inspectors and electrical contractors.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Service Equipment A
  - 2. TM 2 - Service Equipment B
  - 3. TM 3 - Conduit Straps
- D. Assignment sheet #1 - Service Installations
- E. Answers to assignment sheet #1

IV. References:

A. Alrich, Walter N. Electrical Construction Wiring. Chicago, Illinois: American Technical Society, 1977.

B. Graham, Kenneth C. Interior Electric Wiring. 6th. ed., Chicago, Illinois: American Technical Society, 1961.

C. Miller, Rex. Industrial Electricity. Peoria, Illinois: Charles A. Bennett Company, Inc., 1978.

D. Mix, Floyd M. House Wiring. South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.

E. Rockis, Gary. Residential Wiring. Chicago, Illinois: American Technical Society, 1978.

# WIRING THE EXTERIOR
## SECTION 9.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Service entrances

   A. Basic services to service entrance

      1. Service drop (pole)

      2. Underground service (buried)

      3. Service lateral

   B. Placement

      1. Short service wires

      2. Close to kitchen

      3. Avoid outside bedroom wall

   C. Size

      1. Amperage capacity

      2. Voltage capacity

II. Roughing-in a service entrance

   A. Types of service installations

      1. Overhead riser in conduit

      2. Underground in conduit

      3. Underground cabinet type

      4. Mobil home service

   B. Service entrance kit parts

      1. Weatherhead

      2. Pipe strap

      3. Conduit support

    4. Insulator bracket
    5. Roof flashing
    6. Meter socket (generally provided by power company)
  C. The service panel
    1. Typical components
      a. Black wire
      b. Red wire
      c. Neutral wire
      d. Main circuit disconnect
      e. Bus bars (hot)
      f. Neutral bus bar
    2. Voltage and amperage
  D. Service entrance cable
    1. Individual wires
    2. Cable (insulated conductors with helically wound bare conductor)
  E. System grounding (see local electrical code)
    1. Ground rod
    2. Water pipe

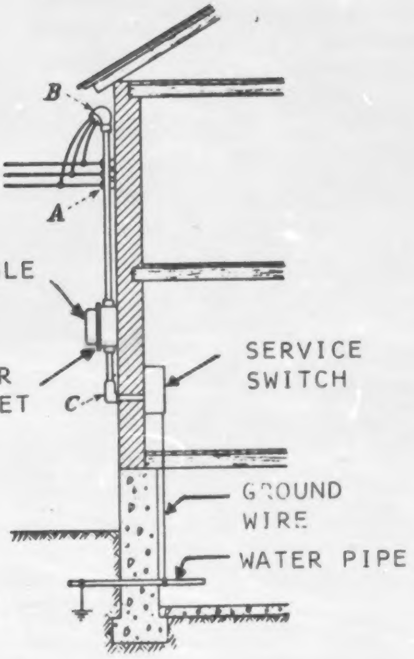
III. Exterior outlets
  A. Ground fault circuit interrupters
    1. Purpose
    2. Applications
      a. Outdoor receptacles
      b. Bathrooms
      c. Construction sites
      d. Swimming pools and fountains

3. Installation methods
    a. Single receptacle protection
    b. Multiple receptacle protection

B. Underground conductors
    1. Watertight conduit
    2. Waterproof cable (type UF)

C. Weatherproof devices
    1. Service entrance parts
    2. Receptacles
    3. Switches

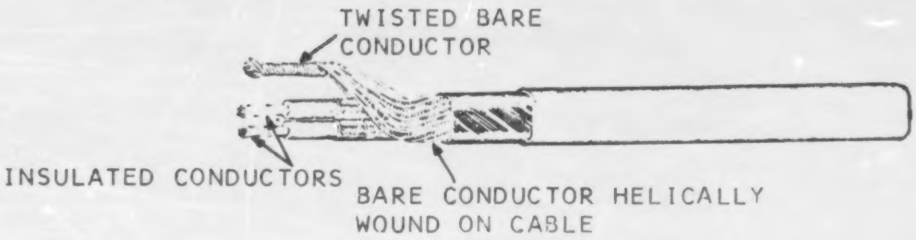
# SERVICE EQUIPMENT A

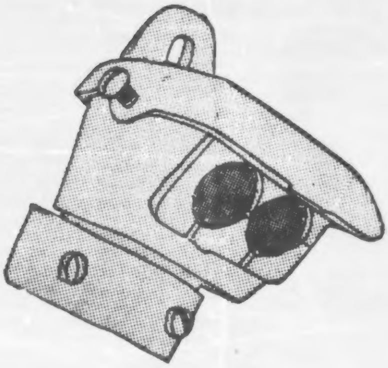


CROSS SECTION OF A TYPICAL SERVICE ENTRANCE. LOCATE THE SERVICE HEAD B HIGHER THAN THE INSULATORS.

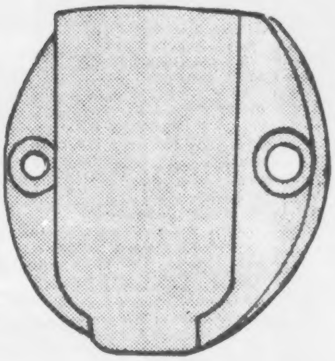
COURTESY OF
MCGRAW HILL BOOK CO.
PRACTICAL ELECTRICAL WIRING
BY H.P. RICHTER; 8TH EDITION
IML-UMC

# SERVICE EQUIPMENT B





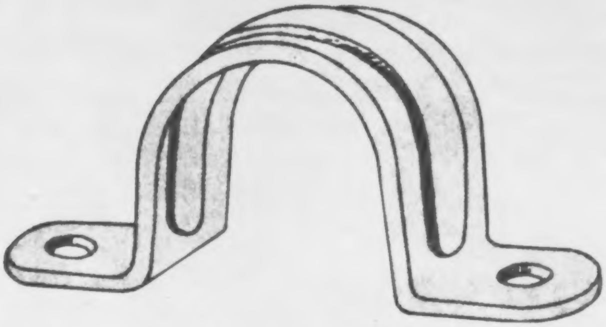
SERVICE ENTRANCE
CAP FOR USE WITH
OVAL SERVICE CABLE.



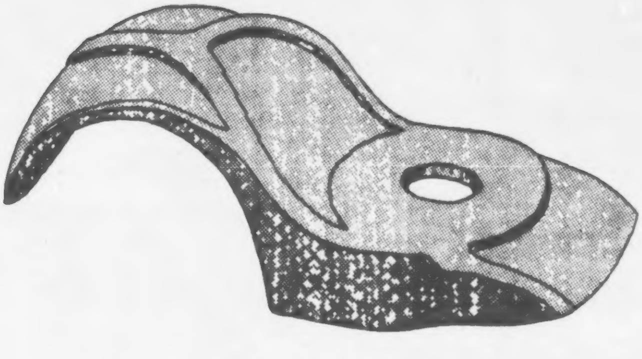
SILL PLATE USED
WITH SERVICE
ENTRANCE CABLE.

COURTESY OF
PRENTICE-HALL INC.
PRINCIPLES & PRACTICES OF
LIGHT CONSTRUCTION
IML-UMC

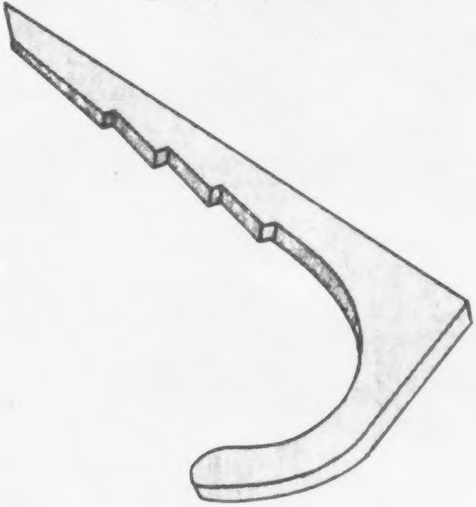
# CONDUIT STRAPS



TWO HOLE



ONE HOLE



NAIL STRAP

## WIRING THE EXTERIOR
## SECTION 9.2.0

## ASSIGNMENT SHEET #1 - SERVICE INSTALLATIONS

After studying the information in the references, match each tern in the right-hand column with the correct description in the left-hand column.

____1. Conductors and equipment for delivering electrical energy from the power company supply system to the wiring system of the house or building to be served

____2. Underground service conductors between the street main and the first point of connection to the service entrance conductors in some type of enclosure

____3. Raceway, usually rigid conduit, that encloses the service entrance conductors

____4. Service conductors between the terminals of the service equipment and a point usually outside the building where joined by a tap or splice to the service drop

____5. That portion of a service raceway that projects through a roof or eave

____6. Water damage protection equipment used when the mast projects from the roof or eave to seal around the raceway

____7. Part of the service entrance that prevents water from entering the top end of the service mast

____8. Conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the grounded conductor of the circuit at the service (ground rod or water pipe)

a. Service raceway

b. Service

c. Overhead service entrance conductors

d. Service drop

e. Service mast

f. Service entrance weatherhead

g. Load center/distribution panel

h. Service lateral

i. Grounding electrode conductor

j. Roof flashing

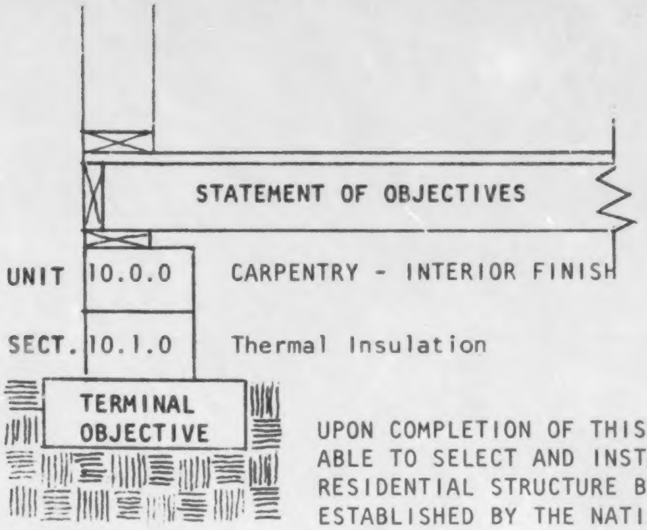
____9. Necessary equipment usually located near the point of entrance of supply conductors to a structure for the purpose of breaker or fuse protection and a means to switch off the supply.

___10. Overhead service conductors from the last supporting structure, usually a pole, connecting to the service entrance conductor at the building or other structure.

# WIRING THE EXTERIOR
# SECTION 9.2 0

## ANSWERS TO ASSIGNMENT #1

1. b
2. h
3. a
4. c
5. e
6. j
7. f
8. i
9. g
10. d



## STATEMENT OF OBJECTIVES

**UNIT** 10.0.0 CARPENTRY - INTERIOR FINISH

**SECT.** 10.1.0 Thermal Insulation

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL BE ABLE TO SELECT AND INSTALL INSULATION MATERIALS FOR A RESIDENTIAL STRUCTURE BASED UPON THE COMFORT LEBELS ESTABLISHED BY THE NATIONAL FOREST PRODUCTS ASSOCIATION.

## SPECIFIC OBJECTIVES

After completion of this section, the learner will:

10.1.1 Write a definition of three (3) heat transfer principles and explain how thermal insulation materials tend to reduce heat transfer.

10.1.2 Write a difinition of insulation that includes energy in the form of heat, sound or electricity.

10.1.3 Differentiate between four (4) general classes of insulation by writing a general descriptive statement of each: (1) flexible, (2) loose fill, (3) reflective and (4) rigid.

10.1.4 Write a definition of the following thermal terms: "BTU", "K", "C", "R", and "U".

10.1.5 Compare the insulation comfort levels established by the National Forest Products Association by listing the three comfort levels and the "U" and "R" factors for ceilings, walls, and floors over unheated spaces.

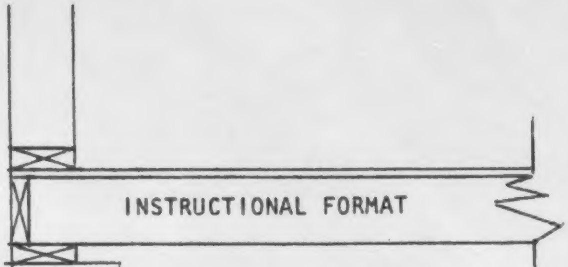
10.1.6 Install flexible batt type insulation in outside walls and ceilings over heated spaces.

10.1.7 Install loose fill insulation to exterior walls and ceiling after interior wall coverings have been applied by blowing into place using appropriate mechanical devices.

NOTE: SPECIAL MACHINES DESIGNED TO BLOW LOOSE INSULATION IN WALLS, CEILINGS OR FLOORS MAY BE RENTED OR SOMETIMES AVAILABLE ON LOAN FROM THE INSULATION SUPPLIER.

10.1.8 Install 2 or 4 mil polyethylene film to inside of exterior walls and ceiling to prevent moisture movement from the interior to the exterior.

NOTE: FLOOR INSULATION MUST BE DELAYED UNTIL ALL MECHANICAL INSTALLATIONS ARE COMPLETED.



UNIT 10.0.0 CARPENTRY - INTERIOR FINISH

SECT. 10.1.0 Thermal Insulation

**INSTRUCTIONAL PROCEDURES**

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

   A. Provide learner with statement of objectives sheet

   B. Discuss terminal and specific objectives

   C. Provide learner with instruction sheets for use with this section

   D. Explain evaluation procedures

II. Suggested instructional methods:

   A. Demonstration - to show manipulative operations at construction site

   B. Discussion - to encourage question and answer activities

   C. Team assignment - to enhance personal relationships in the work environment.

   D. Illustrated lecture - to introduce a lesson or focus attention

   E. Field trips - to illustrate construction techniques and application of materials

   F. Consultant - representatives of local building supply firms, electrical power companies, trade associations and insulation contractors who may supply supplemental information about insulation and conservation of energy, used in the residentaial structure.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Heat Transfer Principles
  - 2. TM 2 - Types of Insulation
  - 3. TM 3 - Thermal Terms
  - 4. TM 4 - Comfort Standards
- D. Assignment sheet #1 - Material Estimating
- E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Spence, William P. Architecture, Design, Engineering, Drawing. 2nd. ed., Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

C. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: Goodheart Willcox Comapny, 1976.

# THERMAL INSULATION
## SECTION 10.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Definition of heat transfer principles

  A. Conduction

  B. Convection

  C. Radiation

II. Insulation

  A. Definition (the property of material which slows down the transmission of energy in the form of heat, sound or electricity)

  B. General classes of insulation

    1. Flexible

    2. Loose fill

    3. Reflective

    4. Rigid

III. Definition of thermal terms

  A. BTU - the amount of heat which will raise the temperature of one pound of water one degree F.

  B. K-value - amount of heat in BTU's that will pass in one hour through one square foot of material one inch thick per 1° temperature difference between faces of the material.

  C. C-value - amount of heat in BTU's that will flow through the material in one hour per square foot of surface with one degree temperature difference.

  D. R-value - total resistance of the wall or insulation material.

  E. U-value - amount of heat in BTU's transmitted in one hour through one square foot of surface, for each degree Fahrenheit difference in temperature between the inside and outside air.

IV. Insulation comfort levels

- A. All-weather comfort standard "R" values
- B. Moderate comfort and ecomony standard
- C. Minimum comfort standards

V. Installing batts and blankets

- A. Wall installation
  - 1. Measuring
  - 2. Cutting
  - 3. Placing
  - 4. Overlapping vapor barriers
  - 5. Fastening/spacing
  - 6. Separate vapor barrier
  - 7. Obstructions
- B. Ceiling installation
  - 1. Position - from below or above
  - 2. Position of vapor barrier

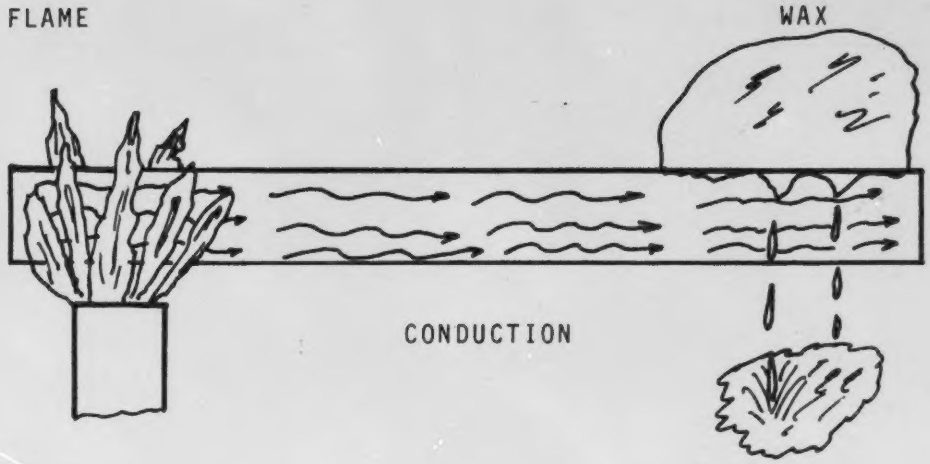
VI. Loose fill insulation

- A. Installation methods
- B. "Blown-in" equipment needs
  - 1. Mixing hopper
  - 2. Flexible delivery hose
  - 3. Shut off valve
  - 4. Forced air source (fan motor attached to hopper)

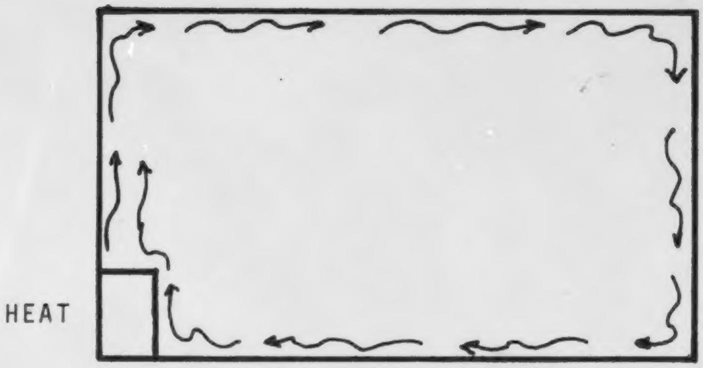
VII. Vapor barriers

- A. Purpose
- B. Materials
  - 1. Asphalt laminated papers
  - 2. Aluminum foil
  - 3. Plastic films
- C. Moisture related problems
  - 1. Exterior paint peeling
  - 2. Interior paint deterioration
  - 3. Decay in structural members
  - 4. Mildew
  - 5. Ineffective insulation qualities

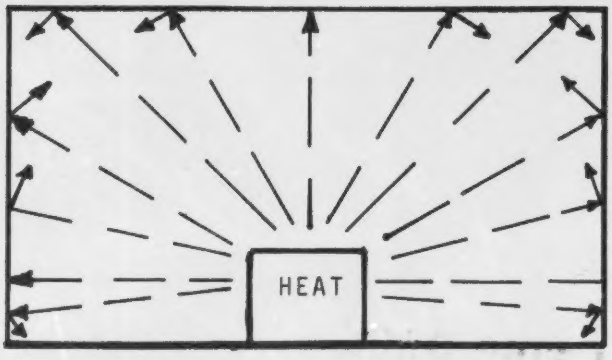
# HEAT TRANSFER PRINCIPLES



CONDUCTION

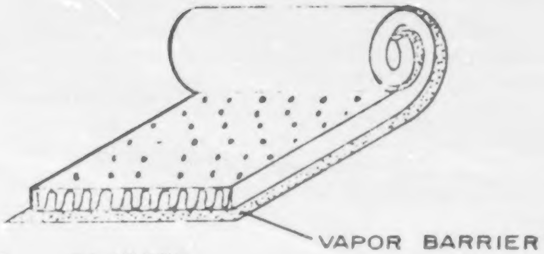


CONVECTION

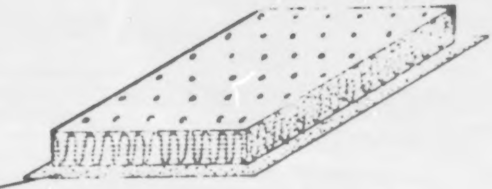


RADIATION

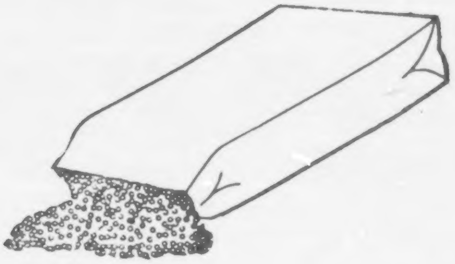
# TYPES OF INSULATION



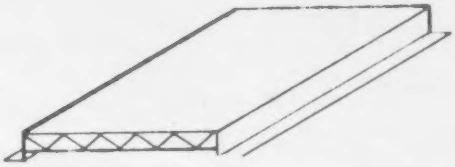
A - BLANKET



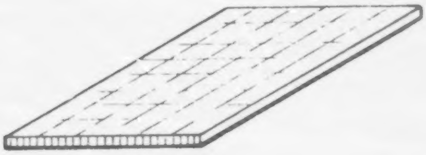
B - BATT



C - LOOSE FILL



D - REFLECTIVE



E - RIGID

# THERMAL TERMS

| | |
|---|---|
| BTU | THE AMOUNT OF HEAT WHICH WILL RAISE THE TEMPERATURE OF ONE POUND OF WATER ONE DEGREE F. |
| K - VALUE | AMOUNT OF HEAT IN BTU'S THAT WILL PASS IN ONE HOUR THROUGH ONE SQUARE FOOT OF MATERIAL ONE INCH THICK PER 1° TEMPERATURE DIFFERENCE BETWEEN FACES OF THE MATERIAL. |
| C - VALUE | AMOUNT OF HEAT IN BTU'S THAT WILL FLOW THROUGH THE MATERIAL IN ONE HOUR PER SQUARE FOOT OF SURFACE WITH ONE DEGREE TEMPERATURE DIFFERENCE. |
| R - VALUE | TOTAL RESISTANCE OF THE WALL OR INSULATION MATERIAL. |
| U - VALUE | AMOUNT OF HEAT IN BTU'S TRANSMITTED IN ONE HOUR THROUGH ONE SQUARE FOOT OF SURFACE, FOR EACH DEGREE FAHRENHEIT DIFFERENCE IN TEMPERATURE BETWEEN THE INSIDE AND OUTSIDE AIR. |

# COMFORT STANDARDS

## ALL-WEATHER COMFORT STANDARD

| | U-VALUE | INSULATION "R" NUMBER |
|---|---|---|
| CEILINGS | 0.05 | R19 |
| WALLS | 0.07 | R11 |
| FLOORS OVER UNHEATED SPACES | 0.07 | R13 |

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## MODERATE COMFORT AND ECONOMY STANDARD

| | U-VALUE | INSULATION "R" NUMBER |
|---|---|---|
| CELINGS | 0.07 | R13 |
| WALLS | 0.09 | R8 |
| FLOORS OVER UNHEATED SPACES | 0.09 | R9 |

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## MINIMUM COMFORT STANDARDS

| | U-VALUE | INSULATION "R" NUMBER |
|---|---|---|
| CEILINGS | 0.10 | R9 |
| WALLS | 0.11 | R7 |
| FLOORS OVER UNHEATED SPACES | 0.11 | R7 |

# THERMAL INSULATION
## SECTION 10.1.0

## ASSIGNMENT SHEET #1 - MATERIAL ESTIMATING

Calculate the amount of insulation materials and labor needed for a house using the specifications below.

______1. Lineal feet of outside wall.

______2. Square feet of wall area.

______3. Total square feet of wall area to be insulated.

______4. Number of 15" x 48" insulating batts needed for outside walls.

______5. Number of staples required to install wall batts at 6" O.C.

______6. Square feet of ceiling area.

______7. Number of 23" x 48" insulating batts needed for the ceiling.

______8. Number of staples required to install ceiling batts at 6" O.C.

______9. Number of hours to install wall 15" x 48" wall insulating batts.

_____10. Number of hours to install 23" x 48" ceiling insulating batts.

_____11. Total number of man-hours to insulate walls and ceiling.

### SPECIFICATIONS

Outside overall deminsions 28' x 52'

Wall height 8'- 0"

Total window and door openings 150 sq. ft.

Ceiling joist spacing 24" O.C.

| INSULATION (BATTS) | | Material | | Staples | Labor |
|---|---|---|---|---|---|
| Size | Square Feet | Number of Batts Per 100 Square Feet | Number of Square Feet for 100 Sq. Ft. Wall | per 100 Square Feet | Square Feet per Hour |
| 15 x 24 | 2.5 | 40 | 95 | 160 | 80 |
| 15 x 48 | 5. | 20 | 95 | 160 | 85 |
| 19 x 24 | 3.7 | 32 | 96 | 160 | 90 |
| 19 x 48 | 6.33 | 16 | 95 | 160 | 95 |
| 23 x 24 | 3.84 | 26 | 95 | 160 | 90 |
| 23 x 48 | 7.67 | 13 | 100 | 160 | 100 |

Notes: Glass, Mineral or Rock Wool batts with paper back roll insulation or strip insulation.
Studding or joist excluded.
Batts stapled @ 6" O.C.

ESTIMATION TABLE FOR BATT INSULATION

## THERMAL INSULATION
## SECTION 10.1.0

## ANSWERS TO ASSIGNMENT #1

1. 160

2. 1280

3. 1130

4. 238

5. 1808

6. 1456

7. 190

8. 2330

9. 13.29

   or 13 hours and 17 minutes

   or 13 1/3

10. 14.56

    or 14 hours and 34 minutes

    or 14 1/2

11. 27.85

    or 27 hours and 51 minutes

    or 28 9/10

## STATEMENT OF OBJECTIVES

UNIT 10.0.0 CARPENTRY - INTERIOR FINISH

SECT. 10.2.0 Interior Wall and Ceiling Finish

**TERMINAL OBJECTIVE**

THE LEARNER WILL, UPON COMPLETION OF THIS SECTION, BE ABLE TO PLAN AND EXECUTE THE NECESSARY CARPENTRY PROCEDURES FOR THE PURPOSE OF INSTALLING AND FINISHING A VARIETY OF INTERIOR WALL AND CEILING COVERINGS.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

10.2.1 List five (5) kinds of interior wall covering products generally used by residential construction designers.

10.2.2 Name the two principle types of interior wall coverings used in residential construction and three advantages of each.

10.2.3 Write the standard gypsum wallboard sizes generally available.

10.2.4 Layout, cut, and install gypsum board to ceiling and walls of structure, observing application techniques that result in the highest strength wall surface with minimum resistance to cracking.

10.2.5 Smooth joints between gypsum wallboard panels by applying joint cement, perforated tape, additional coats of joint cement, and a final sanding level with ceiling or wall surface.

10.2.6 Install prefinished plywood/hardboard/fiberboard paneling to interior wall surfaces. Install directly to wall studs or on furring strips previously positioned. Application may be completed with the use of nails, cement or staples.

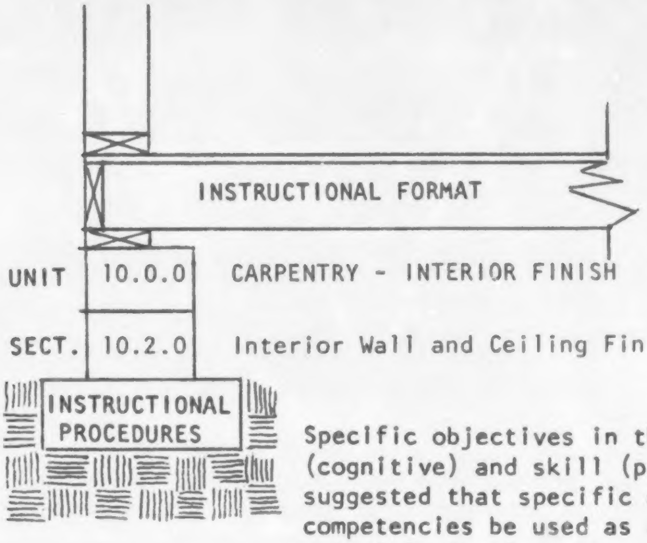
10.2.7 Prime the ceilings and wall surfaces with one coat of a primer paint recommended by a local paint store or information provided by the Painting and Decorating Contractors of America.

10.2.8 Employ a reputable gysum board finishing contractor to apply a texture finish to all ceilings if the specifications call for a spray texture ceiling finish.

NOTE: SPECIAL EQUIPMENT IS NECESSARY FOR SPRAY TEXTURE APPLICATION. EMPLOYMENT OF A SPECIAL CONTRACTOR IS GENERALLY ADVISED.

10.2.9 Layout, cut and install ceramic tile wall coverings to high moisture content areas in the bath, kitchen and laundry areas.

10.2.10 Layout, cut and install plastic laminates to bath/shower/kitchen areas of concentrated mositure.



## INSTRUCTIONAL FORMAT

UNIT 10.0.0 CARPENTRY - INTERIOR FINISH

SECT. 10.2.0 Interior Wall and Ceiling Finish

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

- A. Provide learner with statement of objectives sheet
- B. Discuss terminal and specific objectives
- C. Provide learner with instruction sheets for use with this section
- D. Explain evaluation procedures

II. Suggested instructional methods:

- A. Demonstration - to show manipulative operations at construction site
- B. Discussion - to encourage question and answer activities
- C. Team assignment - to enhance personal relationships in the work environment.
- D. Illustrated lecture - to introduce a lesson or focus attention
- E. Field trips - to illustrate construction techniques and application of materials
- F. Consultant - representatives of local or district labor organization who represent the journeyman carpenter or contractor with special skills and experience in finish carpentry.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Dry Wall Applications
    - 2. TM 2 - Finishing Gysum Dry Wall
    - 3. TM 3 - Wood Panel Application
- D. Assignment sheet #1 - Material Estimating
- E. Answers to assignment sheet #1

IV. References:

A. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

B. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: Goodheart willcox Company, 1976.

## INTERIOR WALL AND CEILING FINISH
## SECTION 10.2.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Kinds of interior wall coverings generally used

  A. Wood

  B. Gypsum

  C. Wallboard

  D. Plywood

  E. Plaster

II. Principle types of interior wall coverings

  A. Advantages of plaster construction

    1. Fine resistant qualities

    2. Durability

    3. Structural rigidity

    4. Resistance to sound transmission

    5. Beauty

  B. Advantages of dry wall construction

    1. Plaster drying time eliminated

    2. Helps to provide full employment for tradesman

    3. More easily repaired

III. Gypsum wallboard

  A. Standard sizes

    1. Thicknesses

    2. Widths

    3. Lengths

- B. Standard edge shapes
  - 1. Tapered
  - 2. Beveled
  - 3. Round
  - 4. Square
  - 5. Tongue and grove

IV. Gypsum wallboard installation procedures

- A. Single layer construction
  - 1. Sequence of application
    - a. Ceiling
    - b. Walls
  - 2. Direction of application
    - a. Ceiling
    - b. Walls
      - 1. Vertical
      - 2. Horizontal
  - 3. Measuring and cutting
  - 4. Nails and screws
    - a. Ceiling spacing (7")
    - b. Wall spacing (5")
    - c. Double nail spacing (12")
    - d. Wallboard fasteners
      - 1. Annular ring nail
      - 2. Smooth shank nail
      - 3. Phillip head screw
      - 4. Adhesives

5. Breaking joints for strength
    a. Openings
    b. Exposed end joints
6. Joint and fastener concealment steps
    a. Embedding coat
    b. Reinforcing tape
    c. Skim coat
    d. Final two coats
        1. Second feathered coat
        2. Final feathered coat
        3. Sanding
    e. Treatment of fasteners
7. Outside corner reinforcement
    a. Metal corner head types
        1. Rigid
        2. Rigid with paper flanges
        3. Flexible
    b. Metal channel trim
    c. Purposes

V. Prefinished paneling
    A. Types
        1. Plywood
        2. Hardboard
        3. Plastic laminates
    B. Installation procedures
        1. Condition for temperature and humidity

2. Layout for minimum cutting and joints

3. Panel arrangement systems
   a. Horizontal pattern - 3 pieces
   b. Two panel horizontal
   c. Vertical panel

4. Joint treatment
   a. Special joint concealment edges
   b. Decorative plastic butt and end strips
   c. Moldings

5. Fastening
   a. Colored cordinated nails
   b. Adhesives
   c. Finish nails
   d. Staples

6. Wall preparation techniques
   a. Direct application to studs
   b. Furring
   c. Gypsum wallboard base

VI. Dry wall and plaster paint undercoat (primer)

A. Purpose of prime coat
   1. Sealer (reduces penetration of succeeding coats)
   2. Less paint needed

B. Types of paint generally used on dry wall or plaster
   1. Flat oil
   2. Alkyed
   3. Latex

C. Roller application procedures

1. Tray-fed rollers

2. Roller nap

3. Room painting sequence

a. Ceiling

b. Walls

c. Wood trim

d. Doors

4. Ceiling procedures

a. Strip painting

b. Lap marks

5. "Cutting in" wall procedure

D. Cleaning brushes and rollers

1. Latex or water thinned paints

2. Other finishing materials

VII. Kinds of texture finishes

A. Brush applied

B. Roller applied

C. Sponge applied

D. Spray applied

VIII. Ceramic wall tile

A. Sizes and styles

1. Standard field tile

2. Tile adhered to backing

3. Decorative

C. Standard tile shapes

  1. Field

  2. Cap

  3. Outside corners

  4. Inside corners

  5. Field caps

  6. Base tile

D. Cutting methods

  1. Tile cutter

  2. Breaking

  3. Drilling

  4. Cutting with abrasive wheel

E. Installation procedures

  1. Layout

  2. Adhesive application

  3. Tile installation

  4. Grouting

    a. Mixing

    b. Application

    c. Removal of excess grout

    d. Striking joints

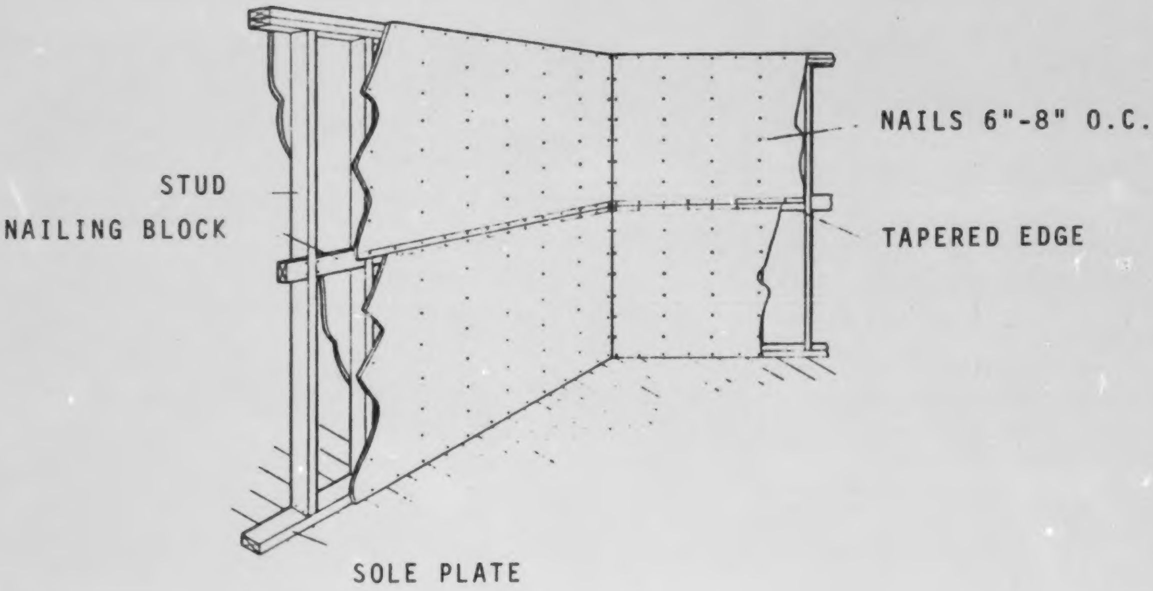
  5. Clearing

IX. Plastic laminate wall installations

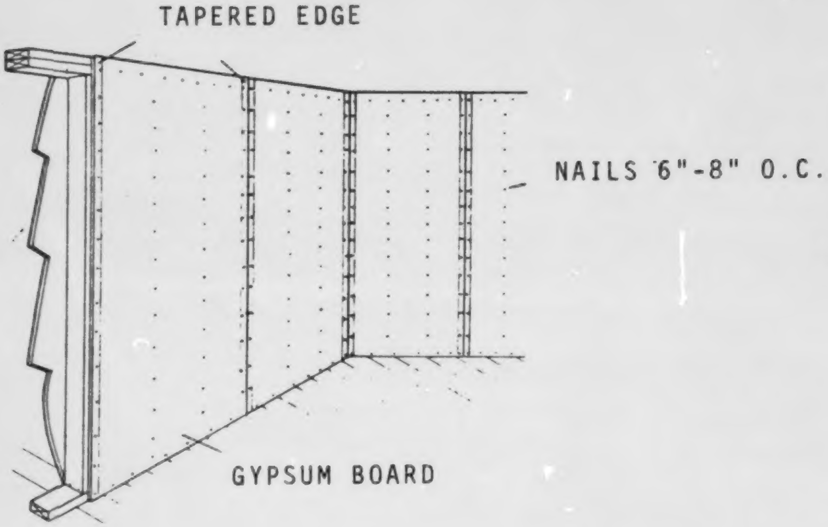
A. Use

B. Installation procedures

# DRY WALL APPLICATIONS

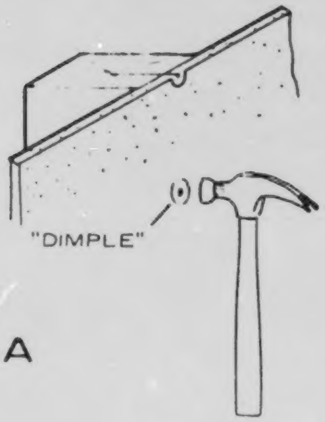


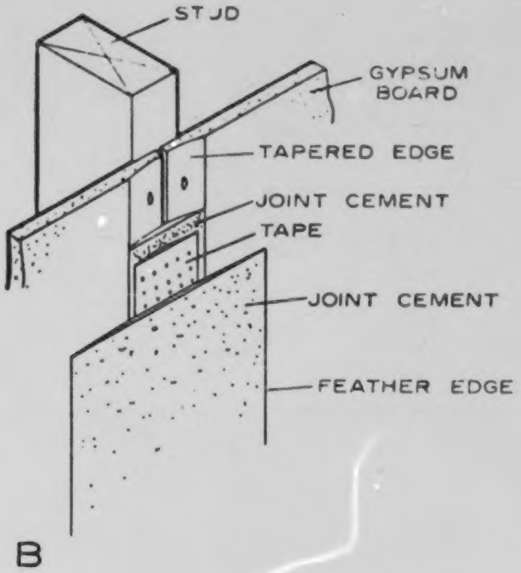
HORIZONTAL

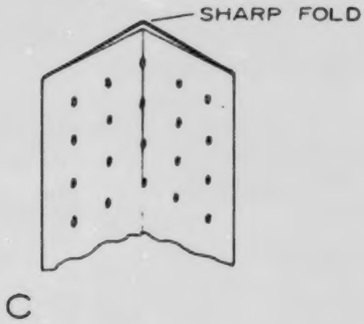


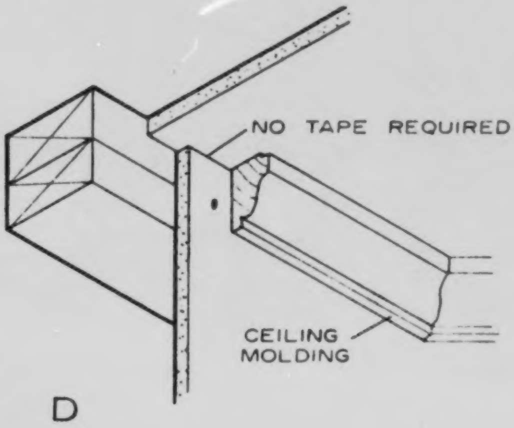
VERTICAL

# FINISHING GYPSUM DRY WALL









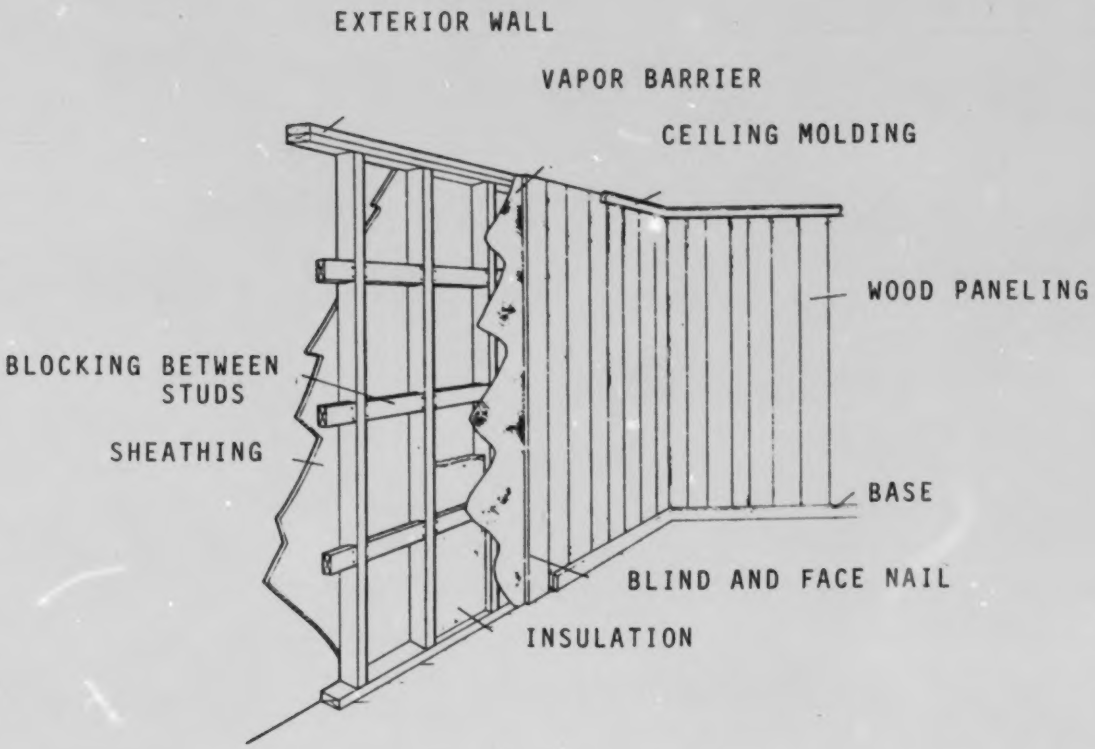
A. NAIL SET WITH CROWNED HAMMER

B. CEMENTING AND TAPING JOINT

C. TAPING AT INSIDE CORNERS

D. ALTERNATE FINISH AT CEILING

# WOOD PANEL APPLICATION



## INTERIOR WALL AND CEILING FINISH
## SECTION 10.2.0

### ASSIGNMENT SHEET #1 - MATERIAL ESTIMATING

After studying the information in the references, calculate the amount of materials needed to apply and finish gypsum wallboard to the living room illustrated below.

__________1. Sq. ft. of 1/2" gypsum wallboard for ceiling.

__________2. Sq. ft. of 1/2" gypsum wallboard for inside of exterior walls (no adjustment for openings).

__________3. Sq. ft. of 1/2" gypsum wallboard for interior partition walls.

__________4. Sq. ft. of 1/2" gypsum needed for complete room.

__________5. Pounds of 1 1/4" annular ring nails (6 1/4lbs. per 1,000 sq. ft. of dry wall).

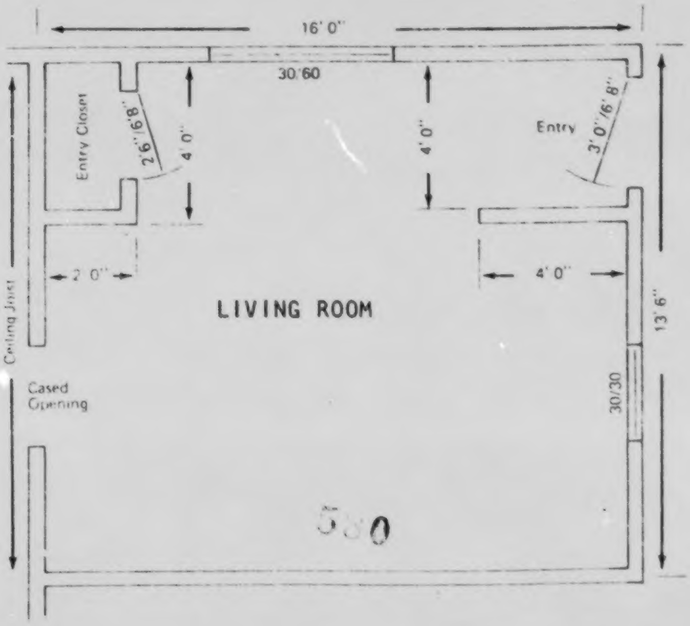
__________6. Feet of perforated tape (50 foot rolls).

__________7. Bags of joint compound (25 pound bags).

__________8. Metal outside corner head (8" length).

__________9. Cost of spray texture application to ceiling (at 12¢ per sq. ft.).

__________10. Additional cost of decorative glitter (at 3¢ per sq. ft.).



# INTERIOR WALL AND CEILING FINISH
## SECTION 10.2.0

## ANSWERS TO ASSIGNMENT #1

1. 216
2. 472
3. 160
4. 848
5. 5.3 or 5 1/2
6. 350
7. 2
8. 3
9. $25.92
10. $ 6.48

## STATEMENT OF OBJECTIVES

UNIT 10.0.0 CARPENTRY - INTERIOR FINISH

SECT. 10.3.0 Interior Trim

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL PERFORM THE FINISH CARPENTRY SKILLS THAT RESULT IN QUALITY COMPLETION OF ALL THE INTERIOR FINISH TRIM GENERALLY FOUND IN THE RESIDENTIAL STRUCTURE.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

10.3.1 Sketch a cross section view and label the following named moldings generally used for contemporary and/or traditional interior designs. Casing, mullion casing, bed mold, stool, apron, stops, cove molds, quarter round, base shoe and baseboard.

10.3.2 Sketch and label two general types of interior doors and their parts.

10.3.3 Read the manufacturers step by step directions first then install all pre-hung interior door units according to the manufactures instructions.

10.3.4 Apply finish trim to all windows and special openings such as a fireplace or special built-in cabinets.

10.3.5 Install kitchen cabinet wall units, base units, and counter top in the order mentioned.

> NOTE: CUSTOM KITCHEN CABINETS ARE GENERALLY INSTALLED BY THE CUSTOM CABINET MAKER. FACTORY PURCHASED UNIT CABINETS ARE GENERALLY INSTALLED BY THE CARPENTER.

10.3.6 Install bathroom wall cabinets by cutting into a previously framed and wired (electrical) opening or by attaching to the wall if a surface installation is specified.

10.3.7 Install bathroom vanity base cabinets and cabinet tops over the plumbing supply and waste pipes extending from the wall.

10.3.8 Trim stairways by removing temporary treads and fitting finished risers and treads to stairhorses.

10.3.9 Finish the stairway by installing trim to areas of "unfinished exposure".

10.3.10 Install stair handrails and protective ornate railings as specified on the architectural plans.

## INSTRUCTIONAL FORMAT

UNIT 10.0.0 CARPENTRY - INTERIOR FINISH

SECT. 10.3.0 Interior Trim

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local or district labor organizations who represent the journeyman carpenter or contractors with special skills and experience in finish carpentry and cabinet making.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
    - 1. TM 1 - Interior Door Frame
    - 2. TM 2 - Door Frame and Trim
    - 3. TM 3 - Interior Doors
    - 4. TM 4 - Door Clearances
    - 5. TM 5 - Window Trim
    - 6. TM 6 - Kitchen Cabinets
    - 7. TM 7 - Basic Types of Stair Risers (see 5.2.0 - TM 16)
    - 8. TM 8 - Enclosed Stairway
    - 9. TM 9 - Main Stair Detail
    - 10. TM 10 - Open Stairway
- D. Assignment sheet #1 - Room Trim Terms and Drfinitions
- E. Assignment sheet #2 - Stair Terms and Definitions
- F. Answers to assignment sheet #1 and #2

IV. References:

A. Cooper, George H. and Stanley Badzinski, Jr. Building Construction Estimating. St. Louis, Missouri: McGraw Hill 1971.

B. Durbahn, Walter E. and Robert E. Putnam. Fundamentals of Carpentry Tools, Materials and Practices. 5th. ed., Chicago, Illinois: American Technical Society, 1977,

C. Durbahn, Walter E. and Elmer E. Sundberg. Fundamentals of Carpentry Practical Construction. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

D. Feirer, John L. and Gilbert R. Hutchings. *Carpentry and Building Construction*. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

E. Putnam, Robert E. and G. E. Carlson. *Architectural and Building Trades Dictionary*. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

F. Smith, Ronald C. *Principles and Practices of Light Construction*. Englewood Cliffs, New Jersey: Prentice Hall Inc., 1970.

H. Wagner, Willis H. *Modern Carpentry*. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

## INTERIOR TRIM
## SECTION 10.3.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Typical molding patterns used for interior trim
    A. Casing
    B. Mullion casing
    C. Bed molds
    D. Stool
    E. Apron
    F. Stops
    G. Cove molds
    H. Quarter round
    I. Base shoe
    J. Baseboard

II. Interior door frames and trim
    A. Parts
        1. Side jambs
        2. Head jamb
        3. Casing
        4. Stop
    B. Kinds of door frames
        1. One piece
        2. Two piece (pre-hung door units)
        3. Three piece (pre-hung door units)

- C. Installing door frames
    - 1. Size check
    - 2. Clearance check
    - 3. Leveling
    - 4. Plumbing with double shingle blocking
    - 5. Blocking locations
    - 6. Nailing
- D. Casing installation
    - 1. Side casings
    - 2. Head casings
    - 3. Corner joints
    - 4. Set-back
    - 5. Nailing

III. General types of interior doors

- A. Panel door parts
    - 1. Top rail
    - 2. Mullion
    - 3. Panel
    - 4. Lock or intermediate nail
    - 5. Stile
    - 6. Bottom rail
- B. Flush door core types
    - 1. Solid
    - 2. Hollow
    - 3. Fiber

C. Flush door parts
   1. Top rail
   2. Core
   3. Stile
   4. Face materials
      a. Plywood
      b. Hardboard
      c. Metal

IV. Pre-hung door units
   A. Types of adjustable door jambs
      1. Two piece
      2. Three piece
   B. Procedure for installing pre-hung interior doors
      1. Criteria for determining hand of door
         a. Face door on hinge side
         b. Knob on left - left hand door
         c. Knob on right - right hand door
      2. Uncrate door
      3. Lay unit on sawhorse with hinges up
      4. Remove lock side fastener (nail through jamb into door)
      5. Separate two halves by lifting the top half
      6. Set top half into the rough opening

         (NOTE: THERE ARE THREE SPACER BLOCKS BETWEEN THE DOOR AND THE SIDE JAMB AND BETWEEN THE DOOR AND HEAD JAMB)
      7. Check jambs and make certain the jambs are against all spacer blocks and that both jambs are on the floor

8. Check trim for plumb

(NOTE: WHEN TRIM IS PLUMB THE UPPER SPACER BLOCK SHOULD BE AGAINST THE HEAD JAMB)

9. Nail trim to wall

(NOTE: ON LOCK SIDE OF DOOR, PUSH THE JAMB TIGHT AGAINST THE SPACER BLOCKS TO MAINTAIN UNIFORM CLEARANCE BETWEEN THE DOOR AND THE JAMB BEFORE NAILING TRIM)

10. Move through opening to opposite side of the door and shim between jamb and stud

(NOTE: CLOSE DOOR WITH SPACERS STILL ATTACHED. PLACE SHIMS AT EACH HINGE ON THE HINGE SIDE AND AT THE TOP, LOCK POSITION, AND BOTTOM ON THE LOCK SIDE)

11. Nail through jamb and shims into stud. DO NOT NAIL THROUGH STOP.

(NOTE: SPACER BLOCKS CAN BE REMOVED AFTER THIS STEP IS COMPLETED)

12. Insert remaining half of jamb and trim into grooved section containing the door

13. Nail trim to wall

14. Nail jamb to studs

(NOTE: NAIL THROUGH STOP)

15. Install lock

16. Check door operation

V. Install finish trim to windows and special openings

A. Window trim parts and sizes

1. Casing

2. Stool

3. Apron

4. Stops

B. Order of installation

   1. Stool
   2. Side casing
   3. Head casing
   4. Apron

VI. Kitchen cabinets

A. Standard size wall units

   1. Heights (usually 3" increments)
   2. Dept (12 1/2")
   3. Widths (usually 3" increments)

B. Standard size base units

   1. Height (34 1/2")
   2. Dept (23")
   3. Widths (usually 3" increments)

C. Types of wall and base units

   1. Single door
   2. Double door
   3. Drawer and door
   4. Drawer
   5. Corner units
   6. Sink bases
   7. Sink and range fronts

D. Order of installation

   1. Wall units
   2. Base units
      a. Corner

        - b. Sink
        - c. Special openings
    - 3. Counter top

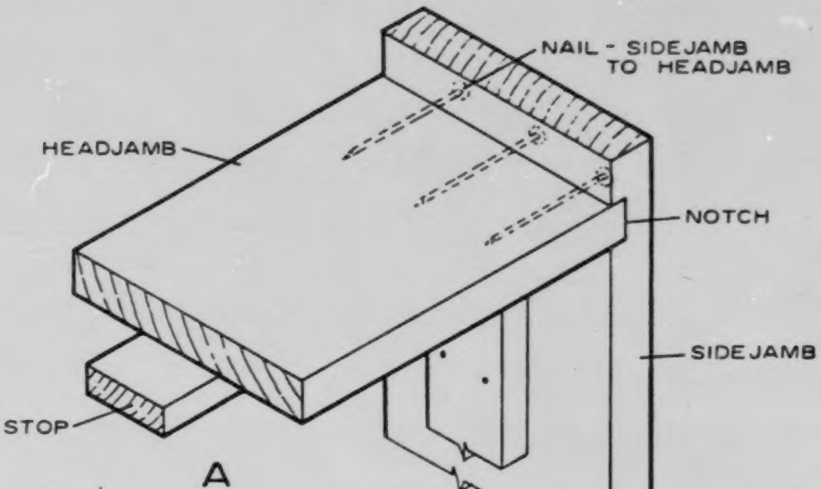
- VII. Bathroom cabinets
    - A. Lighted recessed wall units
    - B. Vanity base units
    - C. Cabinet tops

- VIII. Stairway trim
    - A. Tread and riser construction
    - B. 1. Tread specifications
        - a. Thickness
        - b. Quality of lumber
    - 2. Riser specifications
        - a. Thickness
        - b. Position with tread
    - 3. Nosing width (1 1/8 to 1 1/2")
    - 4. Basic types of stair risers
        - a. Vertical
        - b. Sloping
        - c. Open
    - B. Parts of an open stairs
        - 1. Open stringer
        - 2. Closed stringer
        - 3. Slanting step

        4. Newel
        5. Balusters
        6. Handrail
    C. Principle parts of a balustrade
        1. Newels
        2. Balusters
        3. Rails

IX. Baseboard and base shoe
    A. Purposes
    B. Baseboard styles
        1. Ranch
        2. Colonial
    C. Joint construction
        1. Inside corners
        2. Outside corners
    D. Nailing

# DOOR FRAME - INTERIOR



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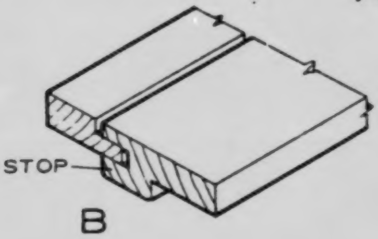

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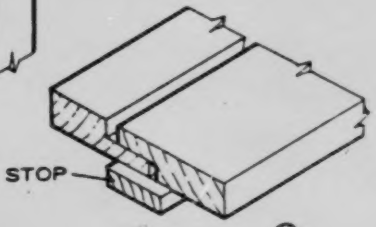

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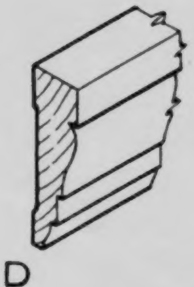

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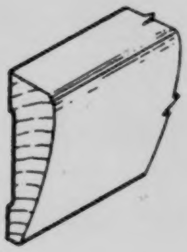
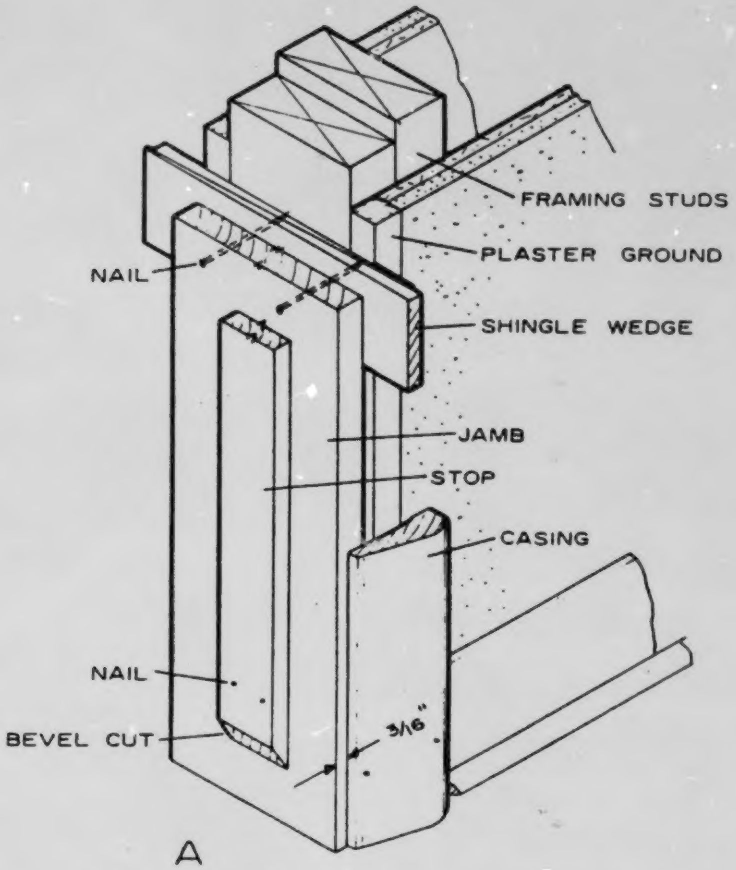


E

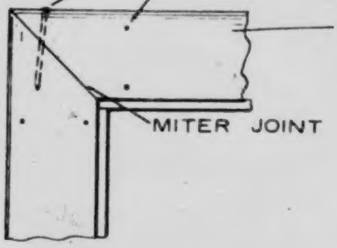
A. DOOR JAMBS AND STOPS
B. TWO-PIECE JAMB
C. THREE-PIECE JAMB
D. COLONIAL CASING
E. RANCH CASING

# DOORFRAME & TRIM



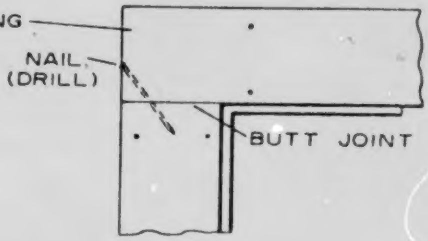
A

INSTALLATION



B

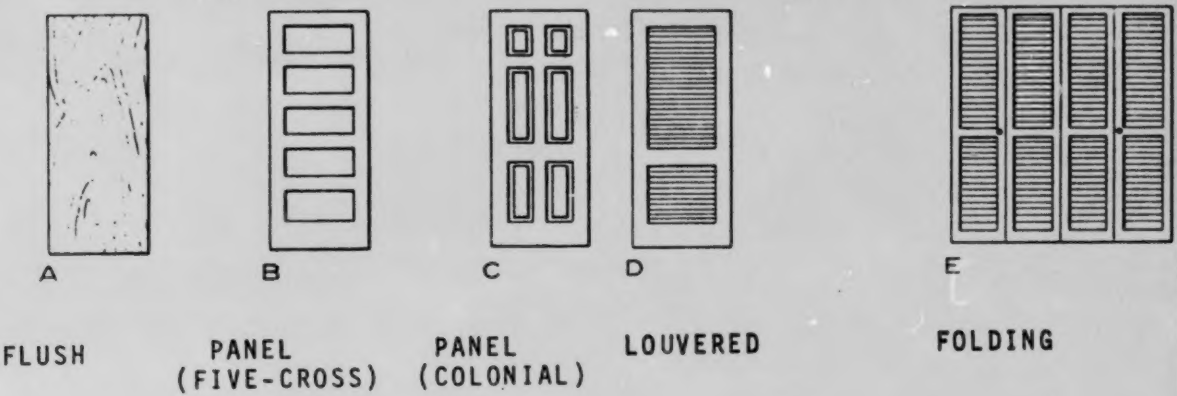
MITER JOINT



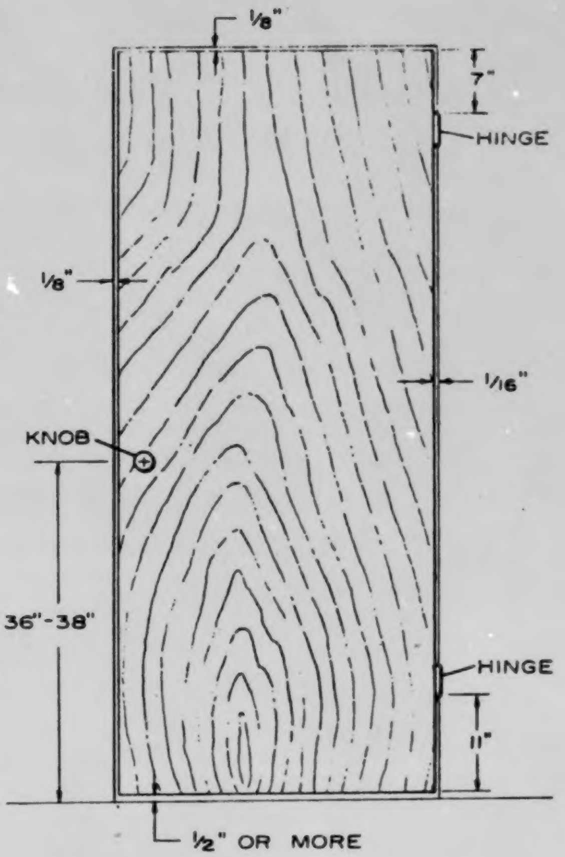
C

BUTT JOINT

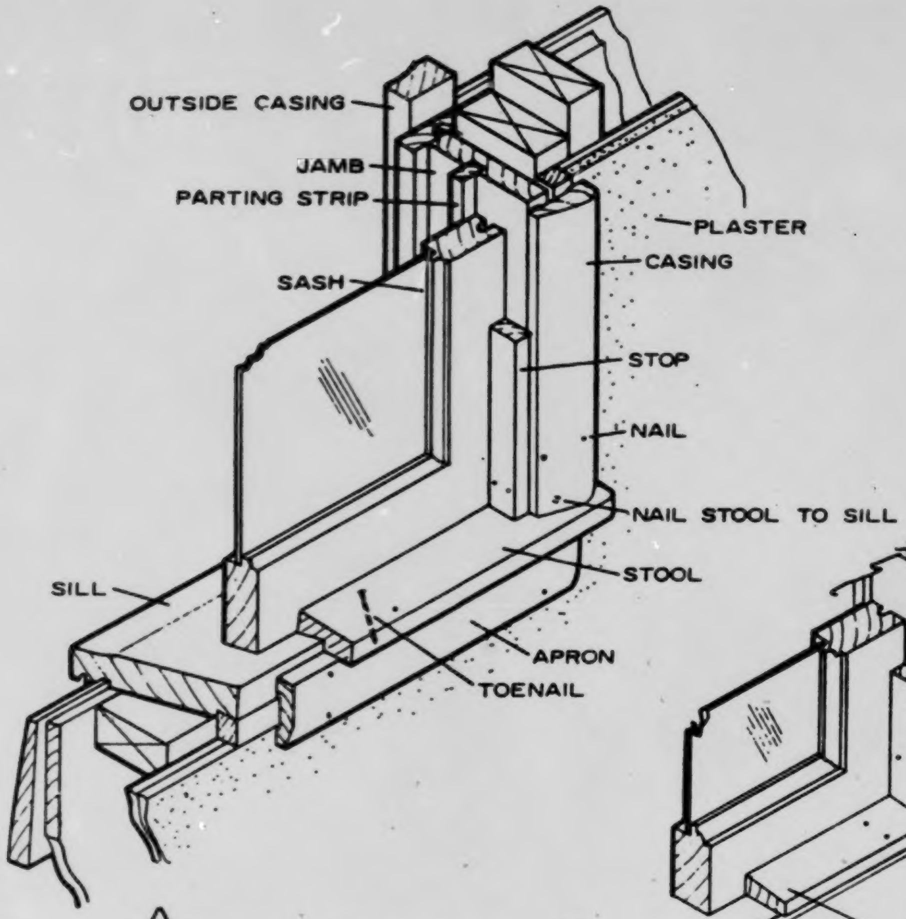
# INTERIOR DOORS



# DOOR CLEARANCES

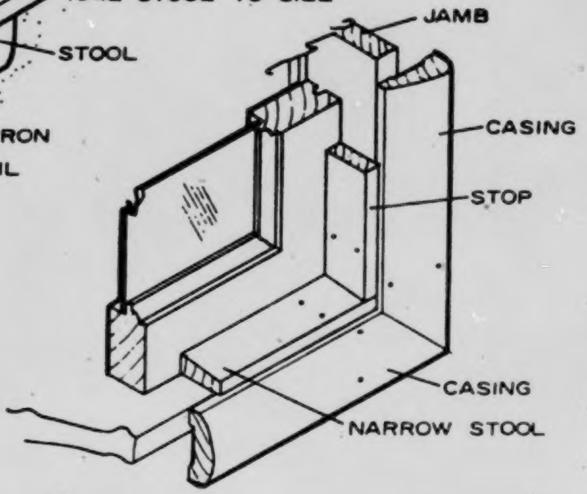


# WINDOW TRIM



A

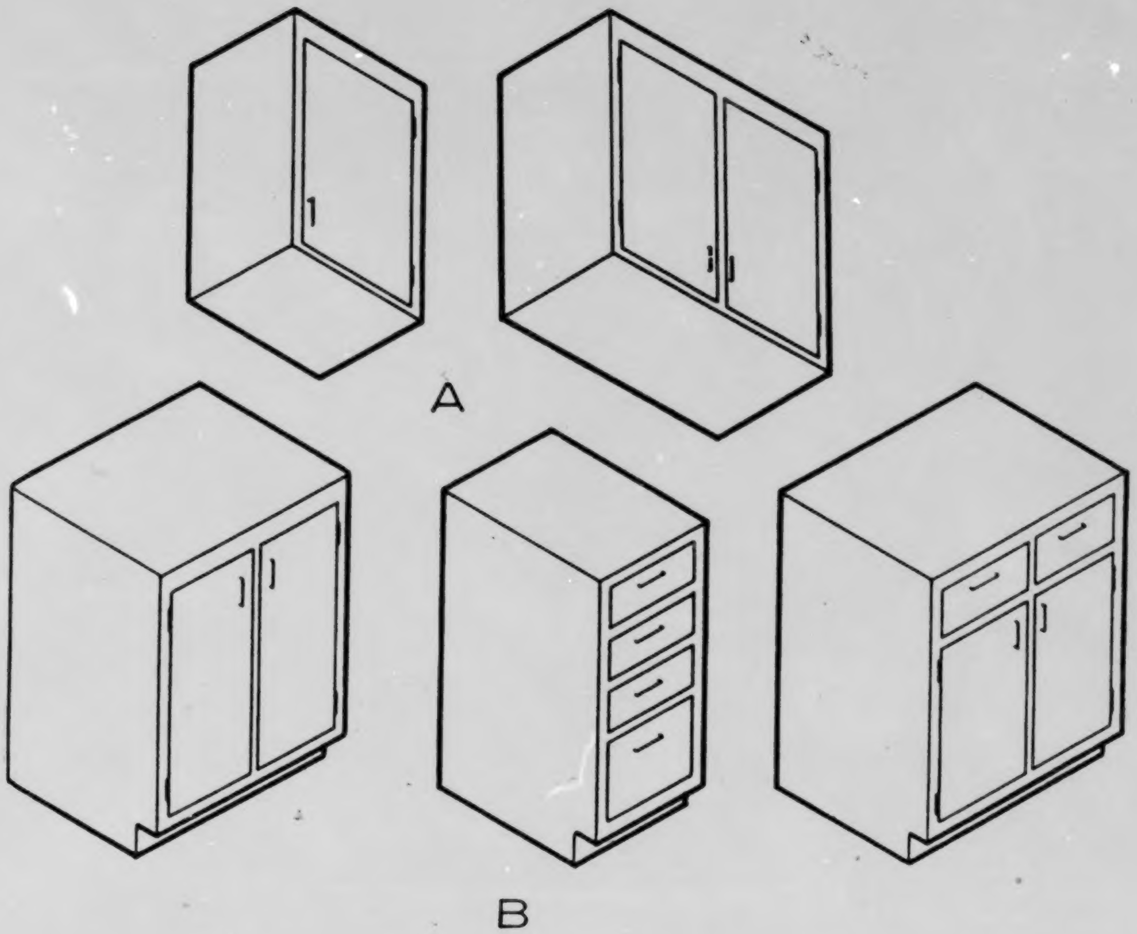
WITH STOOL AND APRON



B

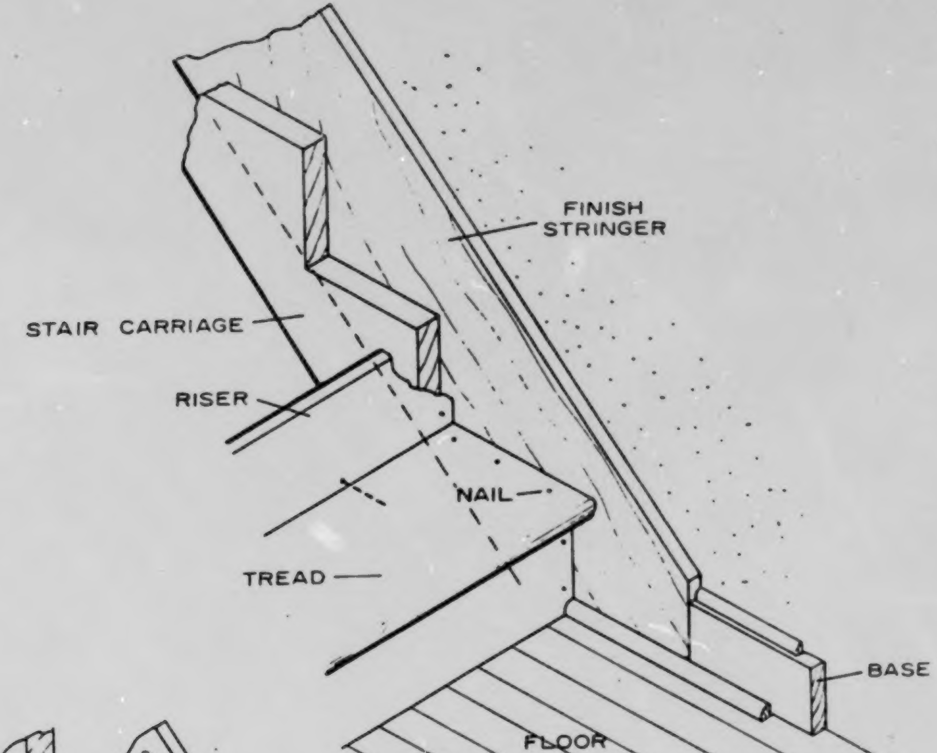
ENCLOSED WITH CASING

# KITCHEN CABINETS

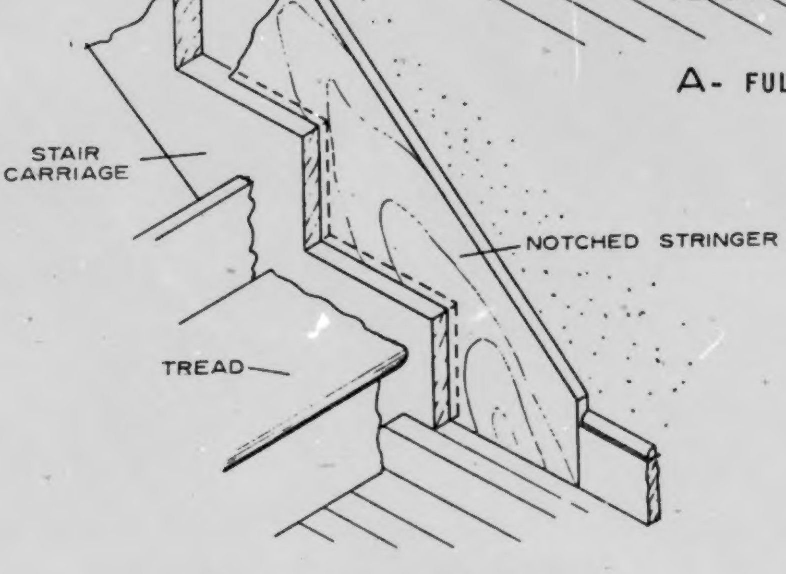


A. WALL CABINETS
B. BASE CABINETS

# ENCLOSED STAIRWAY



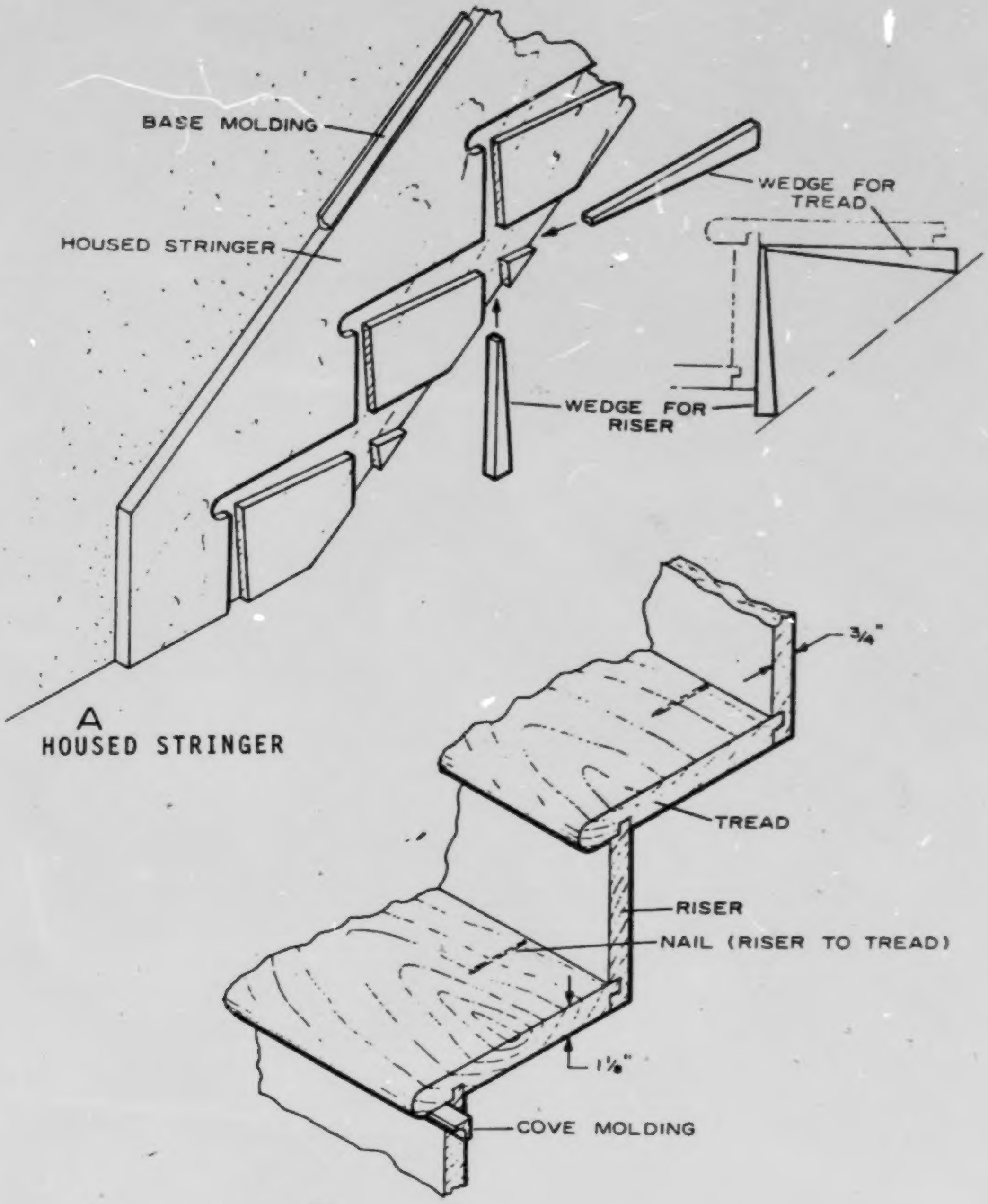
A- FULL STRINGER



B - NOTCHED STRINGER

600

# MAIN STAIR DETAIL

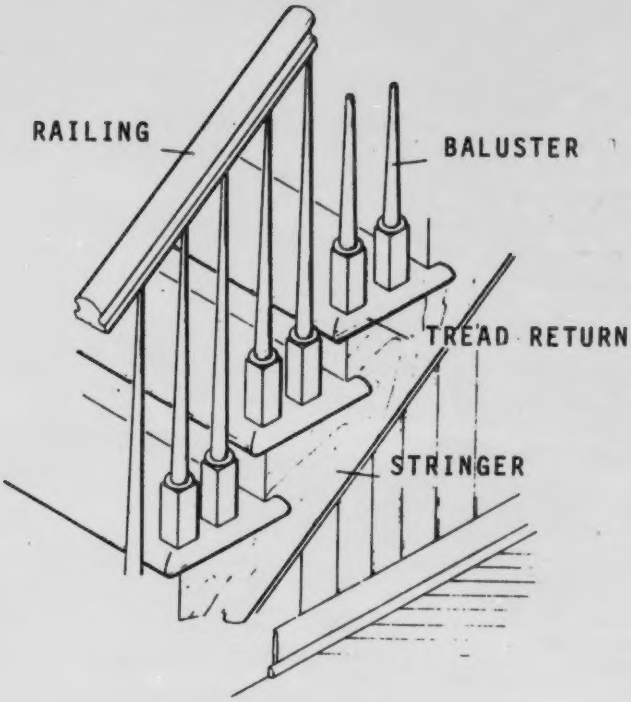


A
HOUSED STRINGER

B

TREADS AND RISER

# OPEN STAIRWAY



## INTERIOR TRIM
## SECTION 10.3.0

### ASSIGNMENT SHEET #1 - ROOM TRIM TERMS AND DEFINITIONS

After studying the infromation in the references match each term in the right-hand column with the correct description in the left-hand column.

______1. An assembly of wood parts that form an enclosure and support for a door

______2. A type of molding which, in cross section, is a quarter of a circle

______3. The two vertical side parts of a door frame

______4. The support at the bottom of a window that extends into the room

______5. A metal or wood member used to close the space between the bottom of a door, (usually exterior) and the floor

______6. A piece of window trim placed horizontally under the stool

______7. A trim board installed at the junction between the wall and floor

______8. The trim around a window or door that covers the opening between door and window jambs

______9. Small narrow molding used around a room where the floor and baseboard meet

______10. To cut or shape the end of a piece of molding so it will cover and fit the contour of an adjoining piece of molding

a. Stool

b. Side jambs

c. Apron

d. Door frame

e. Baseboard

f. Casing

g. Cope

h. Base shoe

i. Threshold

j. Quarter round

## INTERIOR TRIM
## SECTION 10.3.0

### ASSIGNMENT SHEET #2 - STAIR TERMS AND DEFINITIONS

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

______1. The part of a step on which the foot is placed when mounting the stairs

______2. The upright support of the handrail of a stair

______3. The end posts which supports the handrail of a stair

______4. The inclined supports of a flight of stairs

______5. The rounded edge of a stair tread that extends over the riser

______6. A platform located at some point to change the direction of the stair

______7. The horizontal distance between a point at the head of a stair to the outside face of the last riser

______8. Clear space between the top of a stair tread and the ceiling above

______9. An opening extending vertically through a building in which stairs are constructed

______10. The vertical distance between two landings

a. Newel post
b. Nosing
c. Head room
d. Rise
e. Tread
f. Stairwell
g. Run
h. Baluster
i. Landing
j. Stringers

## INTERIOR TRIM
## SECTION 10.3.0

### ANSWERS TO ASSIGNMENT #1 AND 2

| Assignment sheet #1 | | Assignment sheet #2 | |
|---|---|---|---|
| 1. | d | 1. | e |
| 2. | j | 2. | h |
| 3. | b | 3. | a |
| 4. | a | 4. | j |
| 5. | i | 5. | b |
| 6. | c | 6. | i |
| 7. | e | 7. | g |
| 8. | f | 8. | c |
| 9. | h | 9. | f |
| 10. | g | 10. | d |

## STATEMENT OF OBJECTIVES

UNIT 10.0.0 CARPENTRY - INTERIOR TRIM

SECT. 10.4.0 Floor Coverings

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL SELECT AND INSTALL A VARIETY OF FINISH FLOORING MATERIALS COMMONLY USED IN THE COMPLETION STAGES OF THE RESIDENTIAL STRUCTURE.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

10.4.1 List three (3) kinds of hardwood flooring material and contrast their differences.

10.4.2 Prepare the subfloor for hardwood strip flooring installation by thoroughly cleaning, renailing and covering with a good quality 15 lb. asphalt-coated building paper.

10.4.3 Snap a chalk line and face nail the first strip of hardwood flooring to the subfloor about 1/2" to 5/8" from the wall for expansion purposes and at right angles to the floor joists.

10.4.4 Hand nail or use a hammer operated nailer to install successive strips across the rooms.

10.4.5 Face nail the final few courses of hardwood strips on the finished side of the room while exerting pressure to tighten the last few courses.

10.4.6 Employ a floor sanding specialists to sand, stain (if specified), fill (if specified), finish and wax the hardwood installation.

10.4.7 Install an underlayment of plywood or hardboard to areas in the residential structure that are to have resilient type floor coverings.

10.4.8 List five (5) types of resilient floor tile available for use by the professional flooring installer.

10.4.9 Layout the floor for tile installation by snapping two chalklines in the center of the room and at right angles to each other.

10.4.10 Make a trial layout of tile to each wall or projection and measure the distance between the last tile and the wall. Move the center line 1/2 the distance of a full tile closer to the wall if the measured distance between the last tile and the wall is less than 2 inches or more than 8 inches.

10.4.11 Spread adhesive carefully following manufactures recommendations.

10.4.12 Begin laying tile at the center of the room when adhesive becomes slightly tacky, but will not stick to your thumb.

10.4.13 Roll rubber, vinyl and linoleum immediately after installation of a section of the floor.

NOTE: ASPHALT AND VINYL-ASBESTOS TILE DO NOT NEED TO BE ROLLED.

10.4.14 Trim, set border tile and various trim and feature strips if applicable.

10.4.15 Install cove base at junction of floor and walls and around fixtures such as kitchen base cabinet units.

NOTE: A SPECIAL ADHESIVE IS REQUIRED FOR COVE BASE INSTALLATIONS.

10.4.16 Employ a specialized professional flooring mechanic to issue a bid for materials and labor for installation of any sheet flooring materials.

NOTE: THE INSTALLATION OF FLOORING SHEET MATERIAL REQUIRES HIGHLY SPECIALIZED PROCEDURES NORMALLY HANDLED BY THE PROFESSIONAL FLOORING INSTALLER.

# INSTRUCTIONAL FORMAT

UNIT 10.0.0 CARPENTRY - INTERIOR TRIM

SECT. 10.4.0 Floor Coverings

## INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local furniture stores and other business firms that specialize in the sale and installation of floor covering materials

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

1. TM 1 - Types of Strip Flooring

2. TM 2 - Wood Block Flooring

3. TM 3 - Strip Flooring Application

4. TM 4 - Nailing Flooring

5. TM 5 - Resilient Flooring Application

D. Assignment sheet #1 - Floor Covering Materials, Terms and Definitions

E. Answers to assignment sheet #1

IV. References:

A. Durbahn, Walter E. and Elmer E. Sundberg. Fundamentals of Carpentry Practical Construction. 5th. ed., Chicago, Illinois: American Technical Society, 1977.

B. Feirer, John L. and Gilbert R. Hutchings. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.

C. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

D. Putnam, Robert E. and G. E. Carlson. Architectural and Building Trades Dictionary. 3rd. ed., Chicago, Illinois: American Technical Society, 1974.

E. Wagner, Willis H. Modern Carpentry. South Holland, Illinois: The Goodheart Willcox Comapny, Inc., 1976.

# FLOOR COVERINGS
## SECTION 10.4.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Kinds of hardwood flooring materials
   - A. Strip
   - B. Plank
   - C. Pattern or parquet
   - D. Block (form of parquet)
   - E. Common hardwood used
     1. Oak
     2. Maple
     3. Beech
     4. Birch
     5. Pecan
   - F. Common sizes and shapes of hardwood strip flooring
     1. Width (1 to 3 1/2")
     2. Thickness (1/2, 3/8, & 25/32")
     3. Most common 25/32" widths (1 1/2, 2, 2 1/4 and 3 1/4")
     4. Common mill shapes
        - a. Side and end matched
        - b. Side matched
        - c. Square edged
     5. Coverage per bundle

G. Grading
   1. Major trade associations
   2. Oak classified grades
      a. Quarter-sawed
         1. Clear
         2. Select
      b. Plain-sawed
         1. Clear
         2. Select
         3. No. 1 common
         4. No. 2 common

II. Hardwood strip flooring installation procedures
   A. Moisture content equalization at 70°F
   B. Building paper installation
   C. Laying direction
   D. Expansion clearances
   E. Nailing
      1. Starter strip (face nail)
      2. Successive strips (blind nail)
      3. Final strips (face nail)
      4. Type of nails
      5. Size of nails (varies with thickness of strip flooring)
      6. Portable nailer
   F. Staggering end joints in successive courses
   G. Starter pieces (cut from end of preceding course)

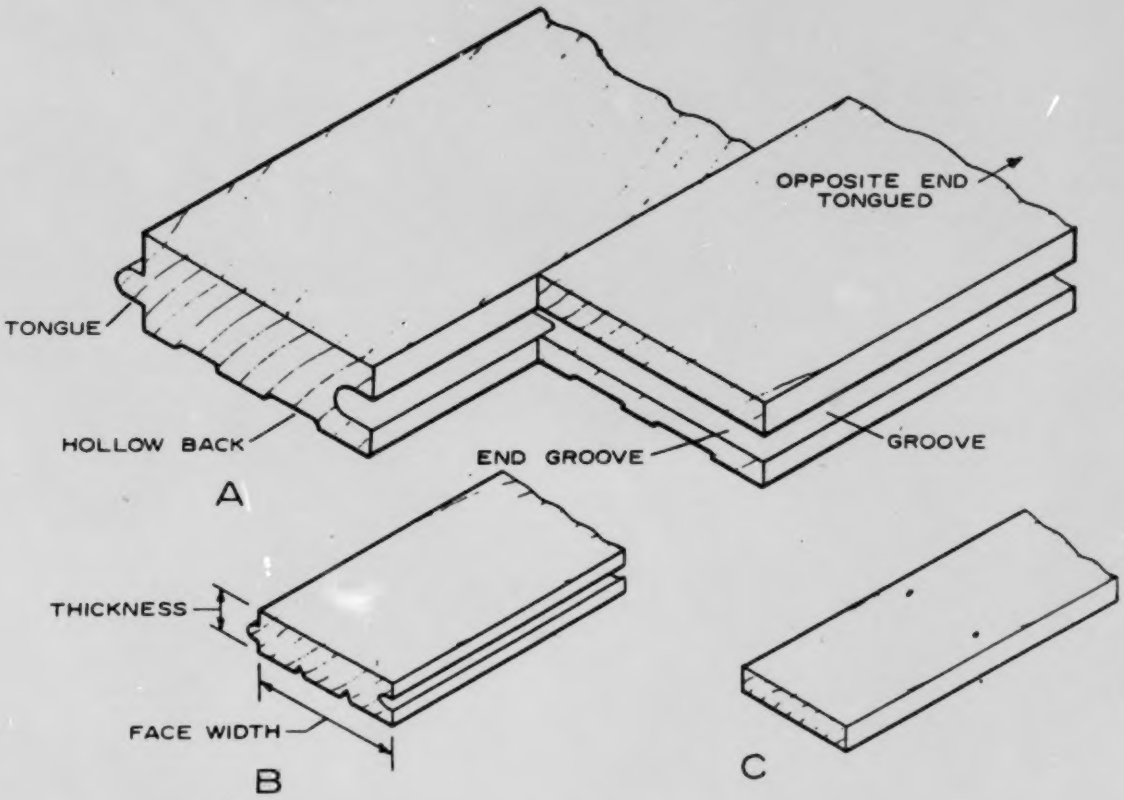
- III. Finishing procedures
  - A. Sanding
  - B. Staining
  - C. Wood filler
  - D. Types of finish
    - 1. Floor seal
    - 2. Varnish
    - 3. Shellac
    - 4. Lacquer
  - E. Waxing
- IV. Resilient floor coverings
  - A. Underlayment
    - 1. Purposes
    - 2. Types
      - a. Hardboard
      - b. Plywood
    - 3. Fasteners
      - a. Ring grooved nail
      - b. Cement coated sinker nail
      - c. Staples
      - d. Spacing
        - 1. Hardboard (6 and 4)
        - 2. Plywood (10 and 6)
        - 3. Plywood under 1/2 inches in thickness (8 and 4)
  - B. Types
    - 1. Linoleum

    2. Asphalt
    3. Rubber tile
    4. Vinyl-asbestos
    5. Vinyl
    6. Carpet

V. Floor tile installation

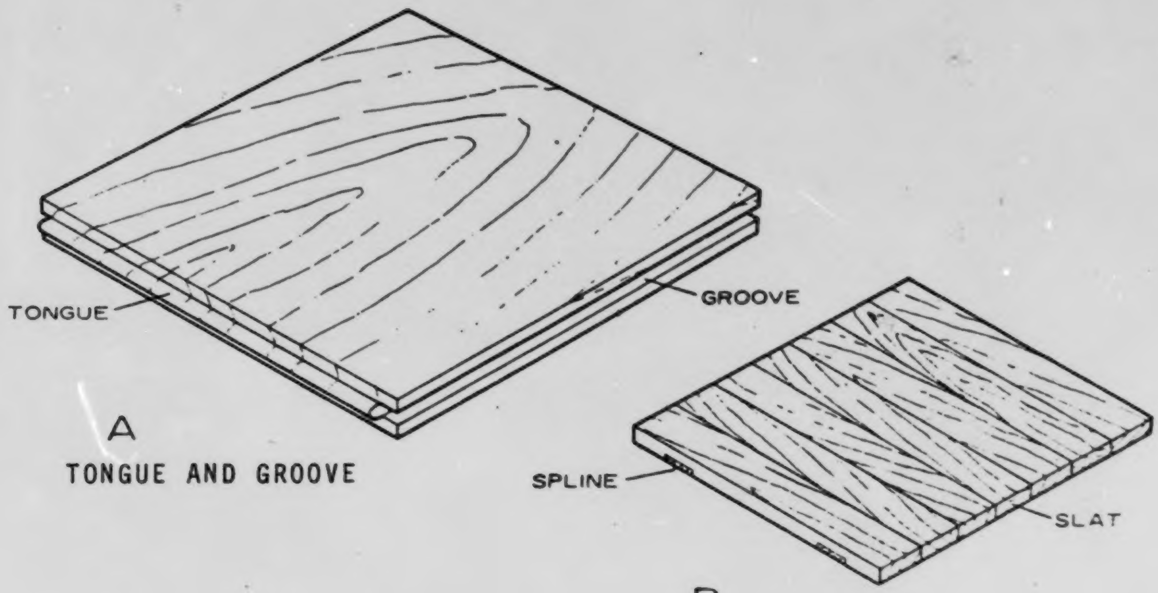
  A. General procedures
    1. Surface preparation
    2. Layout
      a. Establishing main centerline
      b. Establishing second main centerline (at right angles to the first centerline)
      c. Trial layout
      d. Adjustments (main centerline 1/2 tile width)
    3. Spreading adhesive
    4. Laying tile
      a. Starting position
      b. Placing
      c. Setting border tile
      d. Trim and feature strips
      e. Cutting tile
    5. Rolling tile
    6. Cove base
  B. Sheet flooring material
    1. Linoleum
      a. Thickness and grades
      b. Common size

# TYPES OF STRIP FLOORING



A. SIDE AND END MATCHED - 25/32 - INCH
B. THIN FLOORING - MATCHED
C. THIN FLOORING - SQUARE EDGED

# WOOD BLOCK FLOORING



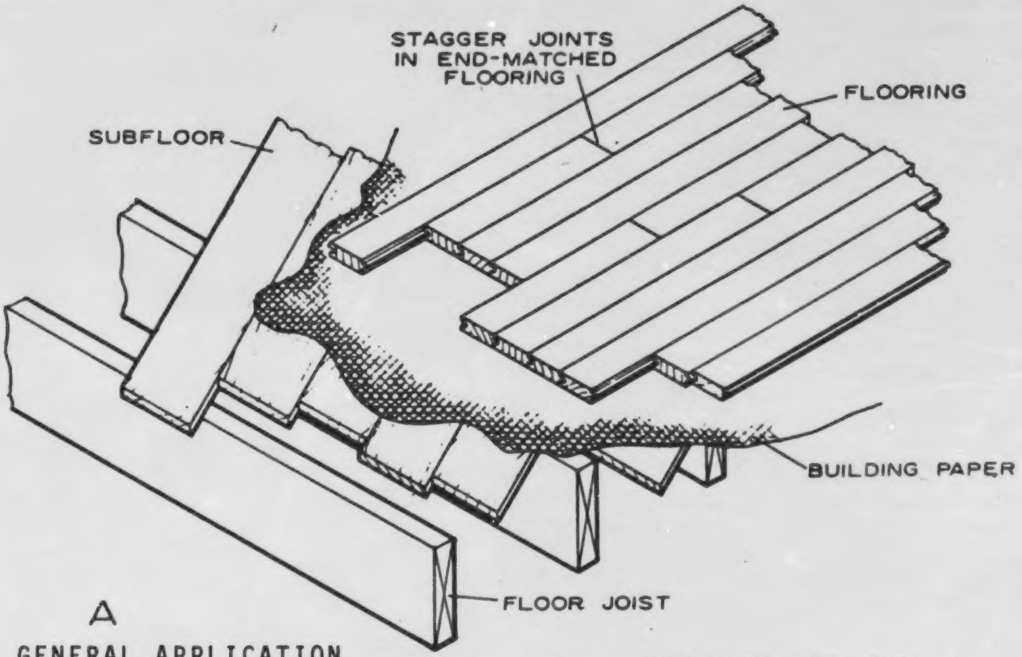
A

TONGUE AND GROOVE

B

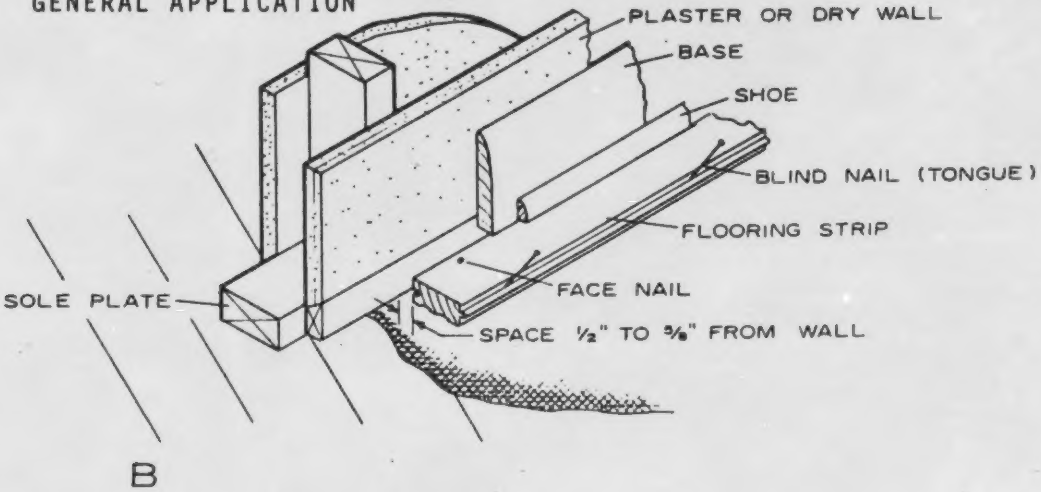
SQUARE EDGED

# STRIP FLOORING APPLICATION



A

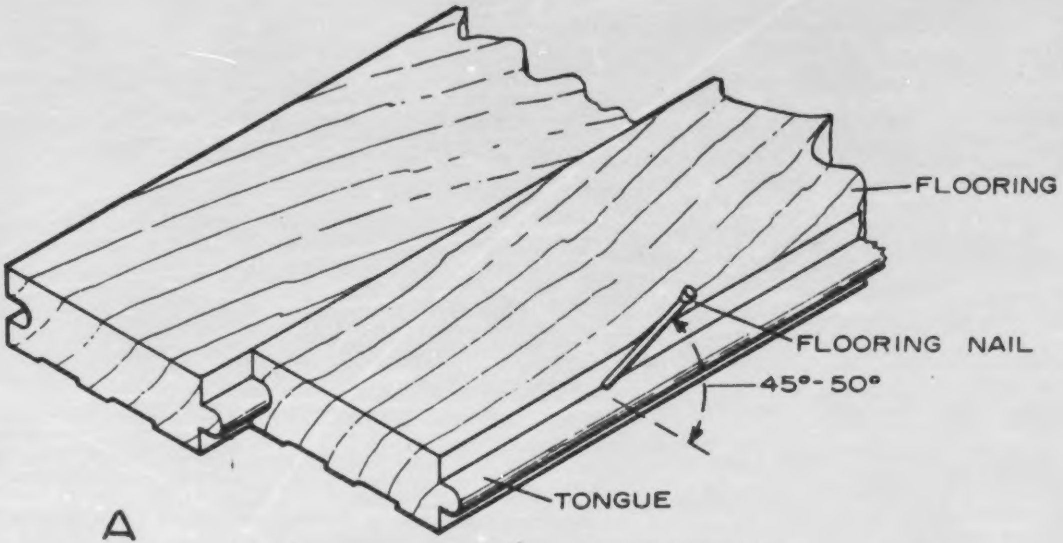
GENERAL APPLICATION



B

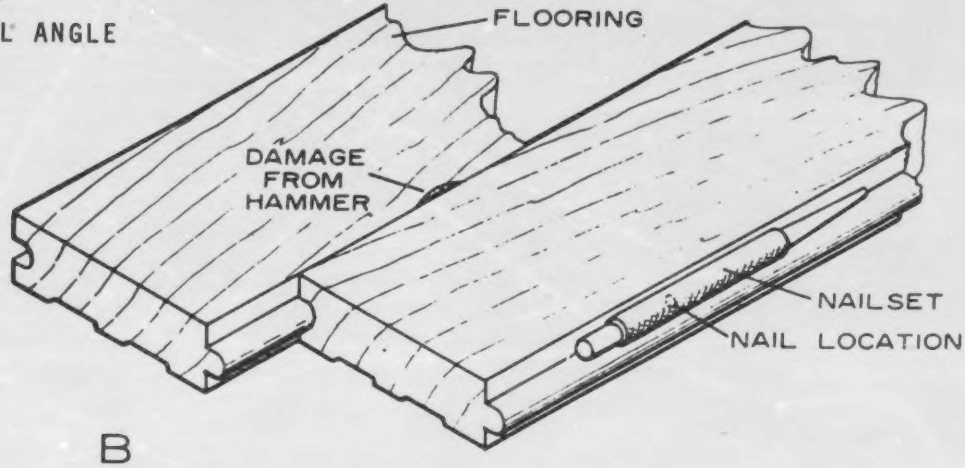
STARTING STRIP

# NAILING FLOORING



A

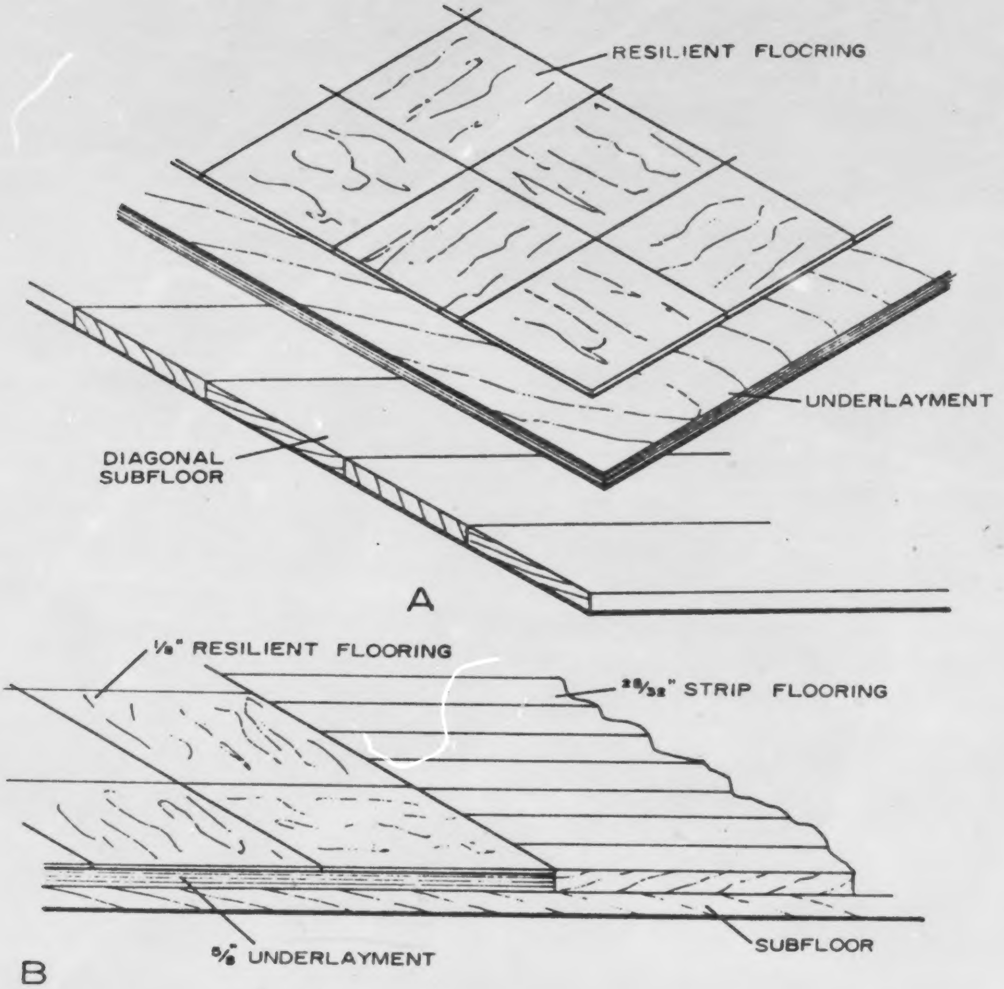
NAIL ANGLE



B

SETTING NAIL

# RESILIENT FLOORING APPLICATION



A. INSTALLATION OVER SUBFLOOR

B. HEIGHT MATCH TO STRIP FLOORING

# FLOOR COVERINGS
## SECTION 10.4.0

## ASSIGNMENT SHEET #1 - FLOOR COVERING MATERIALS, TERMS AND DEFINITIONS

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

______1. The species of wood most commonly used for finish flooring in residential structure

______2. The standard thickness of hardwood strip flooring greater than 1/2 inches

______3. Number of board feet in a standard bundle of hardwood flooring

______4. A classification grade of hardwood strip flooring

______5. A term meaning that successive sides and ends of wood strip flooring are locked together

______6. A procedure for nailing strip flooring that hide the nails from view

______7. The name of the first course of hardwood strip flooring installed, usually paralled and 1/2 inch from the finished wall

______8. A material used to fill the pores of open grained hardwood floors prior to the final top coats of finish

______9. Floor covering of plywood or fiberboard used to provide a level and smooth surface for carpet or other resilient flooring

______10. A commonly used type of resilient floor covering available in a wide variety of patterns, types and grades and is usually manufactured in 6 foot widths

a. 25/32 inches

b. Quarter-sawed

c. Blind nailing

d. Wood filler

e. Linoleum

f. Underlayment

g. Side and end matched

h. Oak

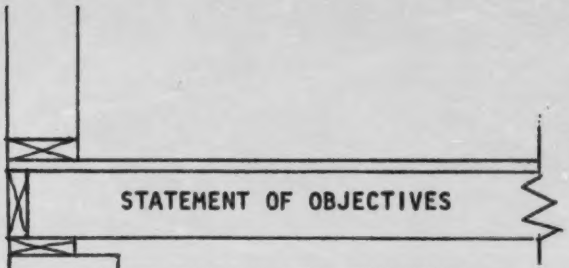
i Starter strip

j. 24

## FLOOR COVERINGS
## SECTION 10.4.0

### ANSWERS TO ASSIGNMENT #1

1. h
2. a
3. j
4. b
5. g
6. c
7. i
8. d
9. f
10. e



## STATEMENT OF OBJECTIVES

UNIT 11.0.0 PAINTING AND FINISHING

SECT. 11.1.0 Interior Painting and Finishing

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL SELECT AND APPLY A VARIETY OF INTERIOR OPAQUE AND TRANSPARENT FINISH COATINGS THAT WILL PROVIDE SUPERIOR PROTECTIVE QUALITIES AND DECORATIVE FUNCTIONS FOR EACH ROOM OF A RESIDENTIAL STRUCTURE.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

11.1.1 Contrast, beginning in ancient times, in chronological order five major paint vehicles that have been developed and have served or are now serving as vehicles for the paint industry.

11.1.2 Name the solvent for each of the following interior wall finishes: (1)latex (2)flat oil (3)semi-gloss enamel (4)flat alkyd

11.1.3 Name three (3) methods in which paint may be applied to interior wall and ceiling surfaces.

11.1.4 Final sand trim to be stained using 150 grit garnet paper if surface does not feel smooth to the fingertips.

11.1.5 Clean dirt, pencil marks, and dust from trim and doors to be stained using a commercial solvent.

11.1.6 Apply oil stain with a brush or sponge, allow a few minutes for penetration, and wipe away surplus with a clean cloth in the direction of the grain and allow to dry 24 hours.

11.1.7 Fill the pores of open-grained trim by applying a commercial paste wood filler. Apply and remove excess according to manufactures instructions. Allow to dry 24 hours.

> NOTE: MUCH DECORATIVE TRIM IS DONE WITH THE USE OF WHITE PINE SPECIES THAT DOES NOT REQUIRE A PASTE WOOD FILLER APPLICATION.

11.1.8 Apply a sealer coat of "thinned top coat material" 24 hours following the paste wood filler application.

11.1.9 Apply two varnish or synthetic top coats and allow adequate time for drying between coats. Smooth between coats using 220 grit abrasive paper to insure a smooth surface.

11.1.10 Apply second coat of paint to ceilings, (unless textured) walls, and trim (if not stained).

NOTE: REMEMBER IT CONSUMES LESS TIME TO PRIME THE WALLS BEFORE BEGINNING THE INTERIOR TRIM APPLICATION. SEE PERFORMANCE OBJECTIVE 10.2.7

11.1.11 Apply final coat of paint to ceiling (unless texture) walls, and trim (if not stained).

11.1.12 Write a step by step procedure for cleaning a paint brush beginning with the first step of dipping in the prescribed solvent and ending with wrapping to preserve its shape.

11.1.13 Write an orderly procedure to follow to insure thorough cleaning of a paint roller and tray.

INSTRUCTIONAL FORMAT

UNIT 11.0.0 PAINTING AND FINISHING

SECT. 11.1.0 Interior Painting and Finishing

INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local paint and decorating businesses and manufactures associations who may provide supplemental information about the painting and finishing industry.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Types of Paint Brushes
- D. Assignment sheet #1 - Painting and Finishing Terms and Definitions
- E. Answers to assignment sheet #1

IV. References:

- A. Brushwell, William. Painting and Decorating Encyclopedia. 4th. ed., South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.
- B. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.
- C. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: Goodheart Willcox Company, Inc., 1976.

## INTERIOR PAINTING AND FINISHING
## SECTION 11.1.0

### INFORMATION SHEET - CONTENT OUTLINE

I. Historical development of paint vehicles
  A. Chronology
    1. Linseed oil (vegetable oils)
    2. Alkyds (synthetic resin materials)
    3. Latex (water base)
    4. Epoxy resins
    5. Acrylic resins
    6. Urethane resins
    7. Vinyls

II. Kinds of paint
  A. Oil paints
    1. Components
      a. Body
      b. Vehicle
      c. Pigment
      d. Thinner
      e. Drier
    2. Uses
  B. Alkyd paints
    1. Chemical combinations (vegetable oils and resins)
    2. Uses (metal and wood products)

C. Resin - emulson paints (latex)

1. Vehicle (synthetic resin emulsion)

2. Uses

D. Metallic paint

III. Solvents and thinners for selected interior wall paints

A. Latex (water)

B. Flat oil (mineral spirits)

C. Semi-gloss enamel (turpentine mineral spirits)

D. Flat alkyd (mineral spirits)

IV. Wall and ceiling paint application equipment

A. Types of rollers

1. Tray or dip

2. Fountain

3. Pressure

B. Types of paint brushes

1. Wall

2. Flat sash and trim

3. Oval sash and trim

4. Angular sash

5. Calcimine

6. Stippling

7. Enamel and varnish

a. Flat

b. Chisel

- C. Types of spray equipment
  - 1. Compressed air
  - 2. Airless

V. Varnishes

- A. Characteristics
  - 1. Transparent
  - 2. Surface enhancement
- B. Components (same as paint)
- C. Resin classification
  - 1. Natural
  - 2. Synthetic
- D. Main types of varnish
  - 1. Spirit (shellac)
  - 2. Oleoresinous varnish
    - a. Exterior spar
    - b. Floor
    - c. Rubbing
    - d. Interior gloss
    - e. Flat and semi-gloss

VI. Enamels

- A. Characteristics
- B. Uses

VII. Lacquers

- A. Types
- B. Uses

VIII. Stains
  A. Types
    1. Water
    2. Spirit
    3. Penetrating oil
  B. Characteristics
  C. Uses

IX. Fillers
  A. Types
  B. Uses
  C. Application methods

X. Sealers
  A. Function
  B. Types
    1. Shellac
    2. Lacquer sealer
    3. Varnish sealer

XI. Wood trim finishing procedures
  A. Smoothing
  B. Cleaning
  C. Staining (if applicable)
  D. Filling (if applicable)
  E. Sealer coat
  F. Smoothing between coats
  G. Top coats
  H. Drying time

XII. Cleaning procedures for application equipment

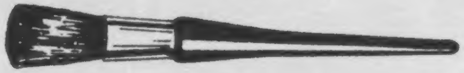
A. Cleaning brushes used in latex paint applications

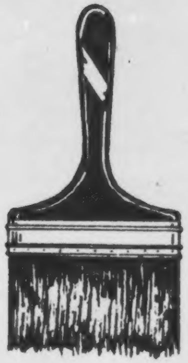
1. Remove excess paint by rinsing in clean warm water (usually a bucket)
2. Wash in warm soapy water (may require two or three washes)
3. Rinse well and allow to dry
4. Wrap in paper or cardboard brush holder
5. Return to storage location

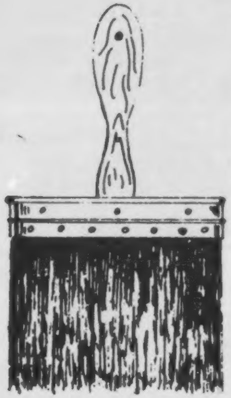
B. Cleaning roller used in latex paint applications

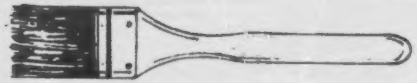
1. Remove excess paint by rinsing in clean warm water (usually in roller pan or bucket)
2. Wash in warm soapy water (may require two or three washes)
3. Rinse well
4. Remove roller cover and allow to dry
5. Return to storage location

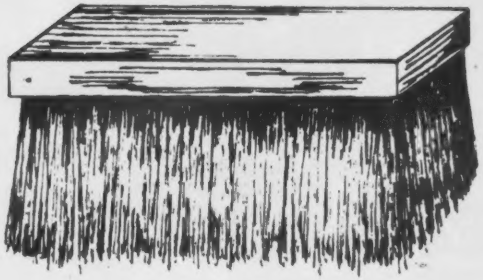
# Types of Paint Brushes

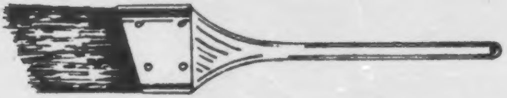

Oval Sash


Calcimine


Flat Wall


Flat Sash and Trim


Stippling


Angular Sash

COURTESY OF:
CURRICULUM AND INSTRUCTIONAL MATERIALS CENTER
STATE DEPARTMENT OF VOCATIONAL-TECHNICAL EDUCATION
STILLWATER, OKLAHOMA
IML-UMC

# INTERIOR PAINTING AND FINISHING
## SECTION 11.1.0

## ASSIGNMENT SHEET #1 - PAINTING AND FINISHING TERMS AND DEFINITIONS

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

______1. Materials which gives paint its color.

______2. Volatile solvents which have a natural affinity for the vehicle in the paint and causes the paint to flow more easily.

______3. Inert materials added to the paint body to increase the volume without increasing the cost significantly.

______4. The common name for resin-emulsion paints.

______5. Colors wood surface without obscuring the grain.

______6. Often leaves fine streaks in the newly painted surface.

______7. Transparent protective resin coating similar to oil base paint.

______8. Reduces surface absorption (reduces penetration).

______9. Requires complex solvents.

______10. A product in liquid or paste form used to fill and seal the open pores of wood.

a. Latex

b. Pigment

c. Brush

d. Sealer

e. Thinners

f. Filler

g. Varnish

h. Extenders

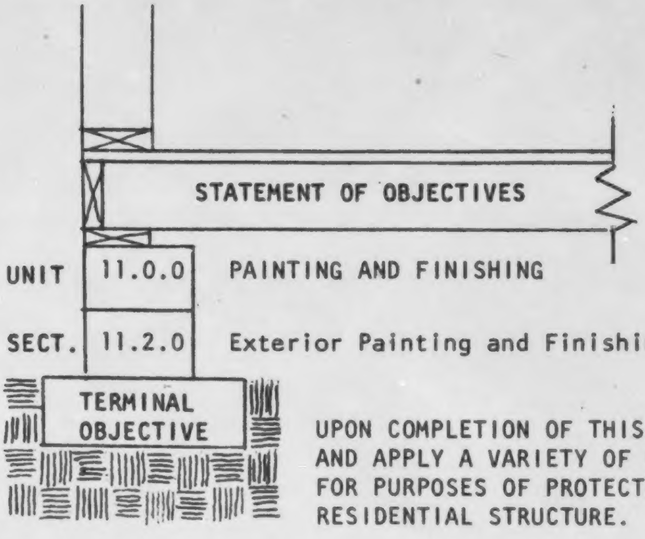
i. Stain

j. Lacquer

## INTERIOR PAINTING AND FINISHING
## SECTION 11.1.0

### ANSWERS TO ASSIGNMENT #1

1. b
2. e
3. h
4. a
5. i
6. c
7. g
8. d
9. j
10. f



## STATEMENT OF OBJECTIVES

UNIT 11.0.0 PAINTING AND FINISHING

SECT. 11.2.0 Exterior Painting and Finishing

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL SELECT AND APPLY A VARIETY OF EXTERIOR PAINT OR STAIN COATINGS FOR PURPOSES OF PROTECTION AND BEAUTIFICATION OF A RESIDENTIAL STRUCTURE.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

11.2.1 List, in chronological order, the primary house paint ingredients as they have developed and changed since the early 20th century.

11.2.2 Write six (6) of the more common types of paints used for outside surfaces and one (1) major advantage of each.

11.2.3 Compare the two types of natural exterior finishes. Explain what happens after application to wood surfaces.

11.2.4 Write a definition of "pressure treated wood".

11.2.5 Name three (3) methods in which exterior finishes may be applied to outside surfaces of a residential structure.

11.2.6 Apply a primer coat of paint by brushing to the trim and siding of a residential structure.

11.2.7 Apply a second finish coat of paint by brushing to the trim and siding of a residential structure.

11.2.8 Caulk around all exterior openings using a caulking gun and a high grade caulking material.

11.2.9 Apply a final coat of paint to the exterior trim and siding.

11.2.10 Write a step by step procedure for cleaning a paint brush beginning with the first step of dipping in the prescribed solvent and ending with wrapping to perserve its shape.

## INSTRUCTIONAL FORMAT

UNIT 11.0.0 PAINTING AND FINISHING

SECT. 11.2.0 Exterior Painting and Finishing

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

- A. Provide learner with statement of objectives sheet
- B. Discuss terminal and specific objectives
- C. Provide learner with instruction sheets for use with this section
- D. Explain evaluation procedures

II. Suggested instructional methods:

- A. Demonstration - to show manipulative operations at construction site
- B. Discussion - to encourage question and answer activities
- C. Team assignment - to enhance personal relationships in the work environment.
- D. Illustrated lecture - to introduce a lesson or focus attention
- E. Field trips - to illustrate construction techniques and application of materials
- F. Consultant - local painting contractors and sales people representing paint manufacturers and businesses that sell paint and decorating products.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Assignment sheet #1 - Material Estimating
- D. Answers to assignment sheet #1

IV. References:

- A. Brushwell, William. Painting and Decorating Encyclopedia. 4th. ed., South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.
- B. Feirer, John L. and Gilbert R. Hutching. Carpentry and Building Construction. Peoria, Illinois: Charles A. Bennett Company, Inc., 1976.
- C. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: Goodheart Willcox Company, Inc., 1976.

# EXTERIOR PAINTING AND FINISHING
## SECTION 11.2.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Changes in house paint ingredients

A. White lead and oil

B. Additives

1. Titanium-dioxide

a. Characteristics

1. Increased whiteness

2. Self-cleaning

2. Petroleum based chemical additives

a. Acrylic resins (used in water-based paints)

b. Alkyd resins

c. Other chemicals

II. Common exterior paints and characteristics

A. White lead

1. Durability (high)

2. Moisture resistance (high)

B. Titanium-lead-zinc

1. Color (bright)

2. Chalk qualities (good)

3. Composition variability

C. Titanium-zinc

1. Cost (less)

2. Discoloring qualities (good)

D. Latex
  1. Application (easy)
  2. Drying (rapid)
  3. Clean up (easy)

E. Paints and enamels for metal
  1. Corrosion resistant primers
  2. Rust-inhibitive top coat

F. Metallic-aluminum
  1. Hiding powers (good)
  2. Moisture resistance (high)

III. Natural exterior finishes

A. Penetrating
  1. Types
  2. Uses

B. Surface
  1. Types
  2. Uses

IV. Chemical treatment of wood

A. Purposes

B. Pressure treatment

V. Thinner and solvents

A. Mineral spirits

B. Turpentine

C. Linseed oil

VI. Methods of painting the exterior

- A. One coat system
- B. Two coat system
- C. Three coat system

VII. Cleaning procedures for application equipment

- A. Tools and equipment
- B. Cleaning brushes used in oil base paint applications
    - 1. Work solvent into the bristles with fingers
    - 2. Squeeze out as much paint and solvent as possible
    - 3. Repeat this operation until paint disappears
    - 4. Give final rinse in clear solvent
    - 5. Wash in warm soapy water and dry
    - 6. Wrap in heavy paper
    - 7. Return to storage location
- C. Cleaning a roller used in oil base paint applications
    - 1. Disassemble and submerge the cover in solvent
    - 2. Work out most of the paint
    - 3. Wash cover in mild detergent solution and rinse in clear water
    - 4. Remove paint from roller frame and pan with proper solvent
    - 5. Return to storage location

## EXTERIOR PAINTING AND FINISHING
## SECTION 11.2.0

### ASSIGNMENT SHEET #1 - MATERIAL AND LABOR ESTIMATING

Estimate the amount of paint needed for the undercoat and one finish coat for the house below. Calculate to nearest 1/4th gallon.

__________1. Number of square feet below the roofline.

__________2. Number of square feet in the gables.

__________3. Total number of square feet to be painted.

__________4. Gallons of undercoat needed (450 sq. ft. of coverage per gal.).

__________5. Gallons of finish coat needed (500 sq. ft. of coverage per gal.).

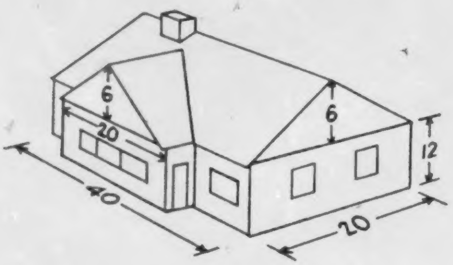
__________6. Number of hours labor to brush wood siding (excludes brushing windows and door frames).

__________7. Number of hours labor to brush windows and door frames (263 linear feet of windows and door frames).

__________8. Gallons of paint needed for one coat of trim undercoat (allow 20% of the amount required for one coat).

__________9. Gallons of paint needed for one finish coat of trim (allow 20% of the amount required for one coat).

__________10. Total labor cost at $12.00 per hour.

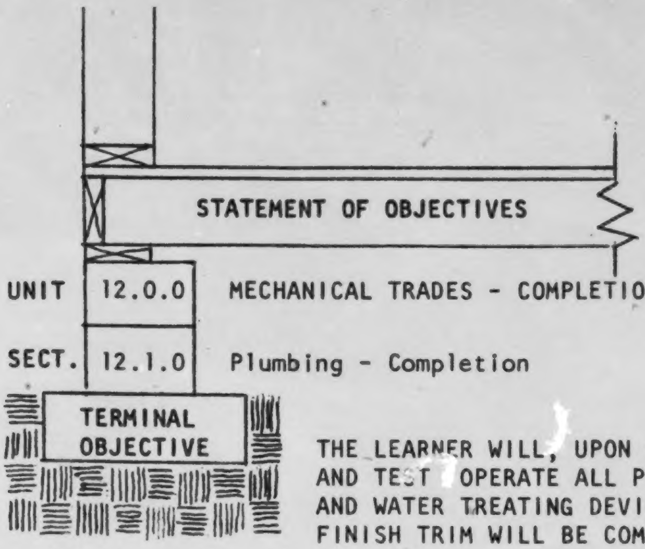


640

## EXTERIOR PAINTING AND FINISHING
## SECTION 11.2.0

### ANSWERS TO ASSIGNMENT #1

1. 1,440
2. 180
3. 1,620
4. 3.6 or 3 1/2
5. 3.24 or 3 1/4
6. 9 1/4
7. 1 1/2
8. .72 or 3/4
9. .65 or 3/4
10. $129.00



## STATEMENT OF OBJECTIVES

**UNIT** 12.0.0 MECHANICAL TRADES - COMPLETION

**SECT.** 12.1.0 Plumbing - Completion

**TERMINAL OBJECTIVE**

THE LEARNER WILL, UPON COMPLETION OF THIS SECTION, INSTALL AND TEST OPERATE ALL PERMANENTLY MOUNTED PLUMBING FIXTURES AND WATER TREATING DEVICES. ALL PIPING CONNECTIONS AND FINISH TRIM WILL BE COMPLETED AND TESTED (IF NOT PREVIOUSLY TESTED).

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

12.1.1 Connect permanent plumbing fixtures to water supply and waste disposal systems in baths, kitchen, laundry, basement, utility and garage areas. Permanent plumbing fixtures include all fixtures connected to the water supply and/or the waste disposal system.

12.1.2 Install water heater in specified position and extend vent through the roof or connect to the furnace vent if a combustible fuel is to be used.

12.1.3 Connect water heater to cold water distribution supply main and hot water distribution supply main.

12.1.4 Connect gas consuming appliances (water heater, clothes dryer, range, incinerator) to previously capped gas pipe risers.

12.1.5 Connect gas piping to special purpose appliances if applicable. Such appliances include gas lights, barecue grills, gas refrigerators and air conditioning compressor units.

12.1.6 Test all water, waste and gas connections for leaks and operate each consuming device to confirm proper working order.

## INSTRUCTIONAL FORMAT

UNIT 12.0.0 MECHANICAL TRADES- COMPLETION

SECT. 12.1.0 Plumbing - Completion

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local or area apprenticeship training schools, journeyman trade craftsman or plumbing contractor.

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

1. TM 1 - Water closet (Installation)

2. TM 2 - Lavatory Hangers

3. TM 3 - Waste Connections (Lavatory)

4. TM 4 - Supply Connections (Lavatory)

NOTE: (see 7.1.0 - TM 2 through 7 and 7.2.0 - TM 2 through 5)

D. Assignment sheet #1 - Plumbing Completion Materials, Terms and Definitions

E. Answers to assignment sheet #1

IV. References:

A. Blankenbaker, Keith E. *Modern Plumbing*. South, Holland, Illinois: The Goodheart Willcox Company, Inc., 1978.

B. Landers, Jack M. *Construction Materials, Methods, Careers*. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

C. Ripka, L. V. *Plumbing Installation and Design*. Chicago, Illinois: American Technical Society, 1978.

# PLUMBING - COMPLETION
## SECTION 12.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Plumbing fixtures
  A. Materials used in fixtures
    1. Vitreous china
    2. Porcelain enamel over steel
    3. Porcelain enamel over cast iron
    4. Stainless steel
    5. Acrylic plastic
    6. Fiber glass reinforced with plastic
  B. Lavatories and sinks
    1. Basic types
      a. Ledge
      b. Self-running
      c. Built-in with metal rim
    2. Installation
      a. Wall hung
      b. Countertop
      c. Vanities
      d. Floor support (legs)
    3. Waste fitting installation
      a. Pop up strainer
      b. P-trap
      c. Slip fittings

4. Faucet installation

    a. Supply tubes

    b. Compression fittings

    c. Shutoff valves

C. Bathtubs

    1. Common materials

        a. Enameled cast iron

        b. Enameled steel

        c. Fiber galss reinforced plastic

    2. Standard lengths

    3. Bathing module (one piece bath and shower)

    4. Installation methods

        a. Recessed

        b. Sunken

        c. Corner

        d. Penisular

    5. Waste fittings installation

    6. Faucet installation

    7. Drain, overflow and stopper assembly installation

D. Shower stalls

    1. Common wall materials

        a. Fiber glass

        b. Enameled steel

        c. Glazed tile

        d. Other waterproof materials

2. Types
   a. Freestanding
   b. Built-in
3. Base materials
   a. Terrazzo
   b. Fiber glass
   c. Cast stone
   d. Enameled steel
4. Common base dimensions
5. Installation
   a. Waste connections
   b. Water valves

E. Water closets
   1. Types
      a. Washdown
      b. Siphon types
         1.) Reverse trap
         2.) Siphon jet
         3.) Siphon action
   2. Installation
      a. Bowl
      b. Tank and fittings

II. Water heater
   A. Types
      1. Fuel as energy sources
      2. Electricity as energy source

B. Energy sources
   1. Natural gas
   2. Liquified petroleum
   3. Oil
   4. Solar
   5. Electricity

C. Materials used in construction
   1. Galvanized steel
   2. Copper
   3. Glass lined steel

D. Selection factors
   1. Fuel available
   2. Capacity
      a. Tank size
      b. Recovery rate
   3. Hot water requirements

E. Gas water heater controls and safety
   1. Thermostat valve
   2. Thermocouple

F. Installation
   1. Venting
   2. T/P (temperature-pressure relief valve)

III. Connection of commonly used gas devices
   A. Water heater
   B. Clothes dryer

C. Range

D. Special purpose appliances

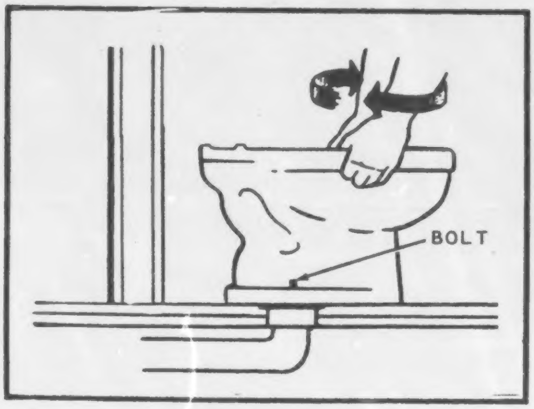
    1. Gas lights
    2. Barbecue grills
    3. Gas refigerator
    4. Air conditioning compressor units (gas operated)
    5. Incinerator

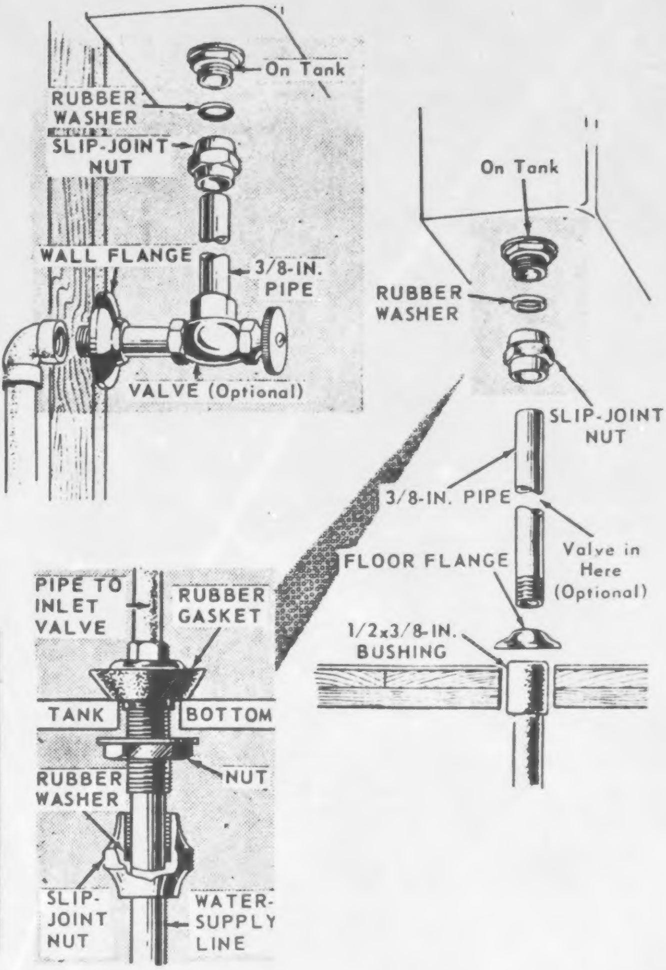
E. Testing connections

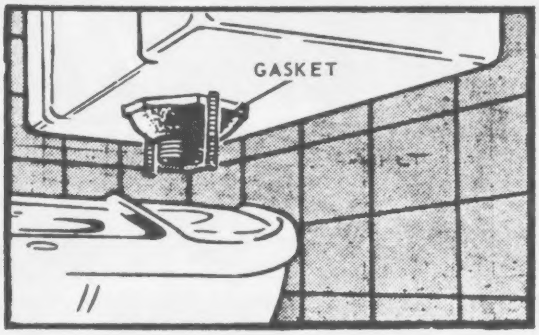
    1. Water
    2. Waste
    3. Gas

# WATER CLOSET

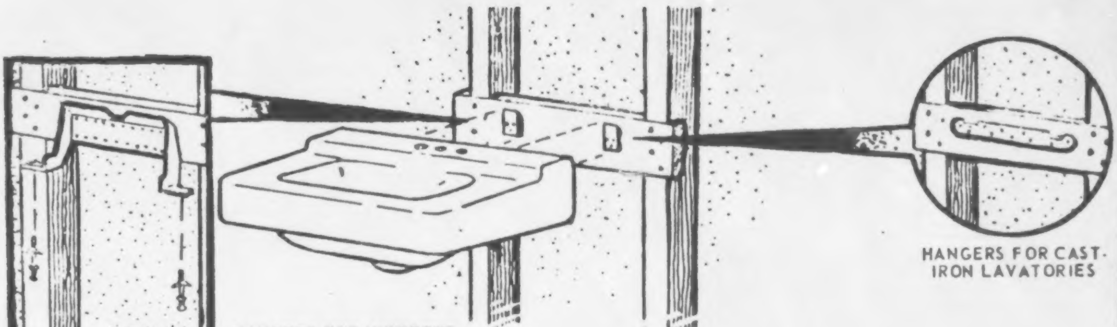
(INSTALLATION)







# LAVATORY HANGERS

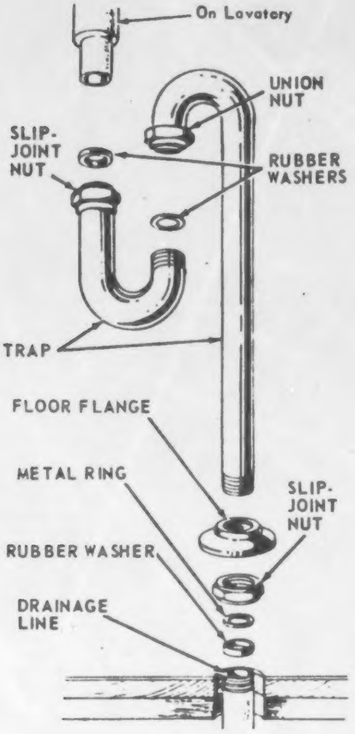


HANGERS FOR VITREOUS CHINA LAVATORIES

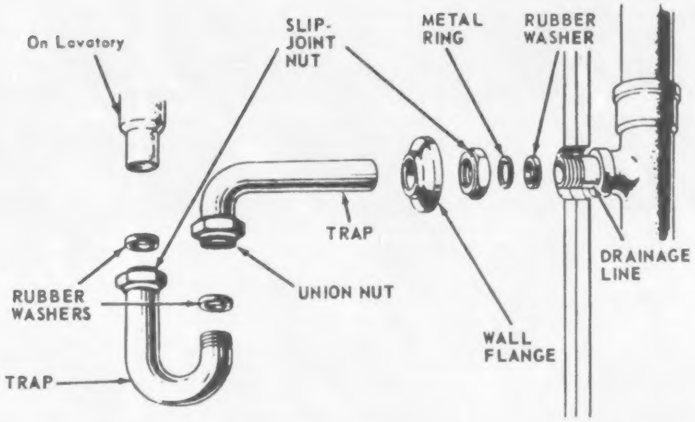
HANGERS FOR CAST-IRON LAVATORIES

# WASTE CONNECTIONS

## (LAVATORY)



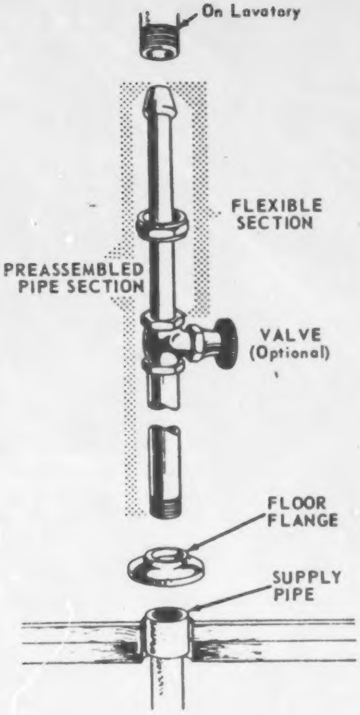
FLOOR



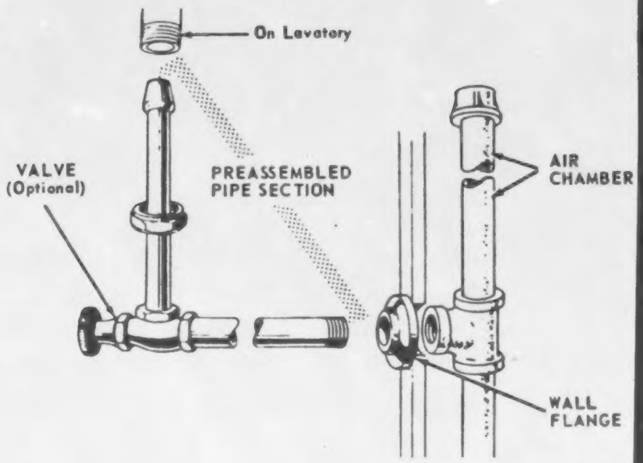
WALL

# SUPPLY CONNECTIONS

(LAVATORY



FLOOR



WALL

# PLUMBING - COMPLETION
## SECTION 12.1.0

### ASSIGNMENT SHEET #1 - PLUMBING COMPLETION MATERIALS, TERMS AND DEFINITIONS

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

________1. A commonly used waste device, to prevent sewer gas from entering the habitable area of a house or building

________2. A special wrench used to tighten the nuts on faucets

________3. Material from which water closets are manufactured

________4. Type of adjustable drainage fittings commonly used to connect fixtures to DWV (drain, waste and vent) piping

________5. The position of the handle from which hot water is always controlled

________6. Type of water supply fittings usually used to connect water supply to lavatory, sink and water closet fixtures

________7. The connecting piece between the water closet trap and the closet bend

________8. The point where cold water enters a water heater tank

________9. A type of water heater that does not require venting to a flue

_______10. A type of piping and fittings used to connect natural gas or oil supply piping to various heating units used in residential structures

a. Basin

b. Vitreous china

c. Compression

d. Near the bottom

e. Electric

f. P-trap

g. Black iron

h. Left

i. Slip

j. Closet flange

# PLUMBING - COMPLETION
## SECTION 12.1.0

## ANSWERS TO ASSIGNMENT #1

1. f
2. a
3. b
4. i
5. h
6. c
7. j
8. d
9. e
10. g

## STATEMENT OF OBJECTIVES

UNIT 12.0.0 MECHANICAL TRADES - COMPLETION

SECT. 12.2.0 Heating and Cooling - Completion

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL COMPLETE THE INSTALLATION OF A DUCTED HEATING AND COOLING SYSTEM, MAKE THE CONNECTIONS FOR PIPED FUEL SOURCES, INSTALL ALL SUPPLY AND RETURN AIR GRILLES AND DIFFUSERS, AND INSTALL VENTS FOR EXHAUST OF COMBUSTION WASTE AND OTHER AIR THAT IS TO BE EXHAUSTED TO THE OUTDOORS.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

12.2.1 Install heating and cooling units and connect to ducted delivery system if applicable.

12.2.2 Connect heating unit to gas supply riser previously placed if applicable.

12.2.3 Extend venting system for heating unit through the roof if a combustible fuel is used to heat the structure.

12.2.4 Install and connect heating and cooling controls. (thermostat)

12.2.5 Place warm air diffusers over register boots in each room and fasten in position at the intersection of the floor and wall.

NOTE: WARM AIR FLOOR DIFFUSERS DROP INTO THE REGISTER BOOT WITHOUT ANY ADDITIONAL FASTENING NEEDED.

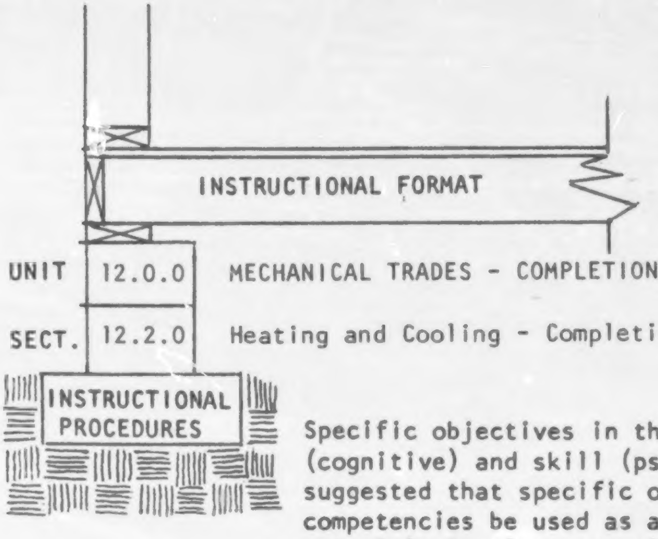
12.2.6 Secure room return air grilles in position using screws supplied.

NOTE: POSITION GRILLES SO THE OBSERVER CANNOT SEE DIRECTLY INTO THE OPENING BEHIND THE GRILLS.

12.2.7 Install humidifier, depending on type, directly on the furnace cabinet, warm air plenum, or within the return or supply air stream. Connect humidifier to cold water supply line using plastic or copper tubing and saddle valve.

NOTE: IF A REMOTE INSTALLATION IS DESIRED, FOLLOW MANUFACTURES DIRECTION.

12.2.8 Provide ducts and roof/wall jacks for all appliances and fans that exhaust air to the exterior of the structure. Generally these include: clothes dryer, cooking ranges, and ceiling or wall mounted exhaust fans.



## INSTRUCTIONAL FORMAT

UNIT 12.0.0 MECHANICAL TRADES - COMPLETION

SECT. 12.2.0 Heating and Cooling - Completion

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of heating and cooling equipment supply firms, trade association representatives, trade contractors and journeyman trade craftsmen.

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Assignment sheet #1 - Heating and Cooling Materials, Terms and Definitions

D. Answers to assignment #1

IV. References:

A. Kicklighter, Clois E. Architecture Residential Drawing and Design. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1973.

B. Landers, Jack M. Construction Materials, Methods, Careers. South Holland, Illinois: The Goodheart Willcox Company, Inc., 1976.

C. Spence, William P. Architecture Design Engineering Drawing. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1972.

# HEATING AND COOLING - COMPLETION
## SECTION 12.2.0

## INFORMATION SHEET - CONTENT OUTLINE

- I. Primary heating and cooling units (counterflow installation)
  - A. Heating
    - 1. Furnace assembly
      - a. Base
      - b. Heat diffuser and burner
      - c. Blower and filters
    - 2. Electrical wiring
  - B. Cooling
    - 1. Cooling assembly
      - a. Evaporator (cooling coil) cabinet
      - b. Evaporator coils
      - c. Compressor-condenser (remote installation)
      - d. Pre-charged refrigerant tubing
    - 2. Electrical wiring
  - C. Venting systems
    - 1. Pre-fabricated metal pipe systems
      - a. Sizes
      - b. Shapes
      - c. Construction
    - 2. Fittings
  - D. Installation procedures - heating units
    - 1. Install furnace on base or coil cabinet
    - 2. Connect return air plenum to return air duct

        3. Connect to gas supply riser

        4. Install thermostat and conncet to gas control valve in furnace

    E. Installation procedures - cooling units

        1. Mount cooling coil in coil cabinet

        2. Place remote compressor-condenser on permanent base

        3. Connect evaporator coil and compressor-condenser units with pre-charged refrigerant tubing

        4. Connect compressor-condenser electrical wiring to circuit from main distribution panel (load center)

        5. Connect low voltage wiring to appropriate terminals (usually attached to furnace in covered electrical outlet box or switch box)

II. Final trim placement

    A. Protection of finished interior

    B. Wall and floor diffuser installation

    C. Thermostat cover

III. Furnace humidifier installation

    A. Direct

    B. Remote

IV. Roof and wall jacks installation for all ducted devices

    A. Clothes dryer

    B. Cooking ranges

    C. Ceiling and wall mounted exhaust fans

# HEATING AND COOLING - COMPLETION
## SECTION 12.2.0

## ASSIGNMENT SHEET #1 - HEATING AND COOLING MATERIALS, TERMS AND DEFINITIONS

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

_______1. A type of forced air heating furnace in which the return air enters the top and moves through the furnace in a downward direction and out to supply ducts usually located in the crawl-space under the structure

_______2. Part of a furnace that heats air as it moves through the furnace

_______3. A device installed at the end of air ducts on exterior surfaces for purposes of preventing back drafts and the entrance of moisture

_______4. Construction principle used to manufacture pre-fabricated sheet metal vent pipes for gas heating installation

_______5. A unit designed to house evaporator coils on counterflow furnace installations

_______6. Final location of low voltage electrical circuit terminals in furnace cabinet that controls burner

_______7. Sealed piping containing freon gas used to connect evaporator coils and compressor-condenser units

_______8. A cover installed over supply air boots to help spread air throughout the room

_______9. A decorative cover used to cover return air openings

_______10. A device sometimes installed in the heating system air flow path to add moisture to the air

a. Double-wall

b. Heat exchanger

c. Coil cabinet

d. Gas control valve

e. Diffuser

f. Grills

g. Humidifier

h. Counterflow

i. Roof-wall jacks

j. Pre-charged refrigerant tubing

# HEATING AND COOLING - COMPLETION
## SECTION 12.2.0

### ANSWERS TO ASSIGNMENT #1

1. h
2. b
3. i
4. a
5. c
6. d
7. j
8. e
9. f
10. g

## STATEMENT OF OBJECTIVES

**UNIT** 12.0.0 MECHANICAL TRADES - COMPLETION

**SECT.** 12.3.0 Electrical - Completion

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL INSTALL AND TEST OPERATE ALL ELECTRICAL CONTROL AND SERVICE MECHANISMS. ELECTRICAL FIXTURES WILL BE INSTALLED AND TEST OPERATED. PERMANENT ELECTRICAL INSTALLATIONS WILL BE CONNECTED AND CHECKED FOR PROPER OPERATION.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

12.3.1 Connect and install all ceiling and wall light fixtures as specified on the architectural drawing and/or local electrical code requirements.

12.3.2 Connect all electrical outlet boxes previously placed as specified on the architectrual drawings and/or local electrical code requirements. Affix wall cover plates to openings where applicable.

12.3.3 Connect garbage disposal to electrical supply as specified by local/national electrical code requirements.

NOTE: GENERALLY BX CABLE IS SPECIFIED FOR THIS APPLICATION.

12.3.4 Connect electrical service to heating unit as specified by local/national electric code requirements. Include control devices as specified by the manufacturer.

12.3.5 Connect dishwasher to electrical power supply as specified by local/national electric code requirements.

12.3.6 Connect air conditioner condensing unit or heat pump to electrical supply using control devices as specified by the manufacturer and in accord with local/national electrical code requirements.

12.3.7 Connect and install all exterior light fixtures as specified on the architectural plans and in accord with local/national electrical code requirements.

12.3.8 Connect other electrical devices not previously completed. These may include wall/ceiling fans, water heaters, cooking ranges, door chimes and other electrical fixtures or appliance as specified on the architectural plans. Connect all electrical devices as specified by the local/national electric code.

12.3.9 After testing all circuits to insure proper functioning, request an inspection of the complete electrical system by the local electrical inspector.

12.3.10 Upon approval of the local electrical inspector, request the local utility company to connect the electric service to the residential structure by placing an electric meter in the service entrance previously installed.

## INSTRUCTIONAL FORMAT

UNIT 12.0.0 MECHANICAL TRADES - COMPLETION

SECT. 12.3.0 Electrical - Completion

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - representatives of local electrical supply firms, trade associations, electrical contractors and journeyman trade craftsmen.

III. Instructional materials used in this section:

- A. Statement of objectives sheet
- B. Information sheet
- C. Transparency masters
  - 1. TM 1 - Wire Nuts
  - 2. TM 2 - Electrical Devices
  - 3. TM 3 - Single Pole Switch Circuits (see 9.1.0 - TM 2)
  - 4. TM 4 - Three Way Switch Circuit (see 9.1.0 - TM 3)
  - 5. TM 5 - Range Plug and Receptacles (see 9.1.0 - TM 4)
  - 6. TM 6 - Circuit Protection Devices
  - 7. TM 7 - Circuit Breaker
  - 8. TM 8 - Fixture Parts
- D. Assignment sheet #1 - Electrical Materials, Terms and Definitions
- E. Answers to assignment #1

IV. References:

A. Alrich, Walter N. Electrical Construction Wiring. Chicago, Illinois: American Technical Society, 1977.

B. Graham, Kenneth C. Interior Electric Wiring. 6th. ed., Chicago, Illinois: American Technical Society, 1961.

C. Miller, Rex. Industrial Electricity. Peoria, Illinois: Charles A. Bennett Company, Inc., 1978.

D. Mix, Floyd M. House Wiring. South Holland, Illinois: Goodheart Willcox Company, Inc., 1973.

E. Rockis, Gary. Residential Wiring. Chicago, Illinois: American Technical Society, 1978.

# ELECTRICAL - COMPLETION
## SECTION 12.3.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Electrical connections

  A. Supplies

    1. Solder

    2. Tape

    3. Solderless connectors (wire nuts)

      a. Purposes

      b. Sizes

  B. Splices

    1. Types

      a. Pigtail

      b. Western union

      c. T-tap

    2. Soldering splices

    3. Taping splices

  C. Solderless connectors

    1. Types

      a. Plastic end caps

      b. Split bolt connectors

      c. Screw terminals

      d. Back wired (quick)

      e. Crimp type

II. Wall and light fixture installation

- A. Mounting methods
  - 1. Direct
  - 2. Hickey (reducer)
  - 3. Fixture straps and threaded nipples
- B. Switching installations

III. Receptacle installations

- A. Mounting method
- B. Grounding
- C. Cover plates
- D. Switching situations
  - 1. Duplex receptacle
  - 2. Split-wired

IV. Connection to permanent electrical fixtures/appliances

- A. Garbage disposal
  - 1. Conductor requirements
  - 2. Switching
- B. Heating units
  - 1. Control devices
  - 2. Voltage
- C. Dishwasher (built-in)
  - 1. Voltage
  - 2. Conductor requirements
- D. Air conditioner condensing unit
  - 1. Voltage
  - 2. Exterior conductor protection

V. Exterior light fixture installations

A. Mounting methods

B. Resistance to elements

C. Decorative exterior lighting

VI. Connections to other electrical consuming devices

A. Wall and ceiling fans

1. Voltage

2. Trim installation

B. Water heaters

1. Voltage

2. Controlled usage installations

C. Cooking ranges/ovens

1. Voltage

2. Locations

VII. Circuit protection devices

A. Types of fuses

1. Plug fuse

2. Fustat

3. Fustron

B. Circuit breaker

VIII. Low voltage fixture installations

A. Door chimes

1. Control devices

2. Transformer location and installation

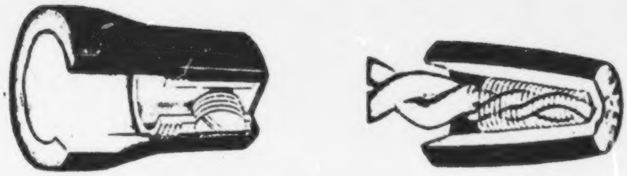
B. Intercommunication devices

        1. Radio
        2. Intercom
        3. Television receptacle
            a. Cable
            b. Antenna
            c. Antenna rotor
        4. Other

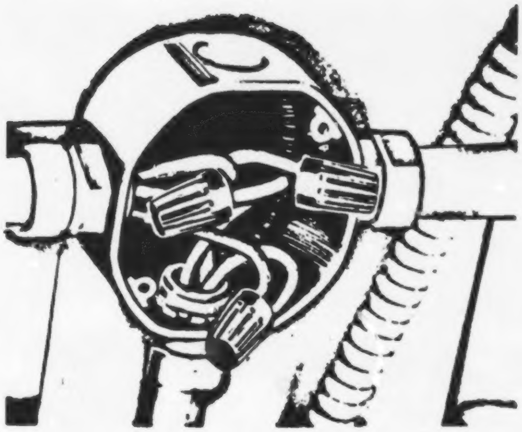
IX. Inspection

    A. Local electrical inspector
    B. Power company requirements

# WIRE NUTS



TWO TYPES OF SOLDERLESS CONNECTORS

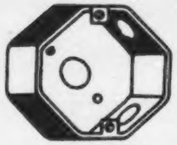


THIS SHOWS THE USE OF SOLDERLESS CONNECTORS

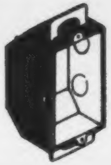
COURTESY OF
MCGRAW HILL BOOK CO.
PRACTICAL ELECTRICAL WIRING
BY H.P. RICHTER; 8TH EDITION
IML-UMC

# Electrical Devices

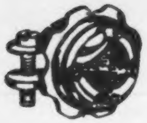
50 Amp 115/230 v. Cord
Receptacle Cap



Octagon Box

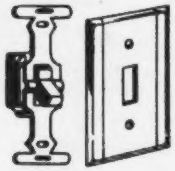


Beveled Corners
Wall Box

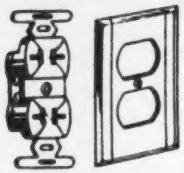


Connector

Time Delay Fuse
40 Amp Cartridge Type



Toggle Wall Switch
and Cover



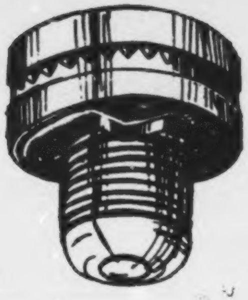
Duplex Receptacle
and Cover

Single Element Fuse
30 Amp
Edison Plug Type

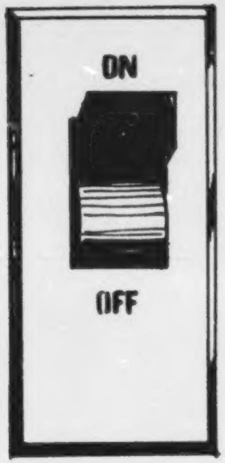
12.3.0 - TM 2

COURTESY OF:
CURRICULUM AND INSTRUCTIONAL MATERIALS CENTER
STATE DEPARTMENT OF VOCATIONAL-TECHNICAL EDUCATION
STILLWATER, OKLAHOMA
IML-UMC

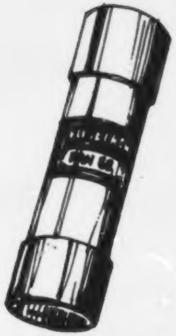
# Circuit Protection Devices



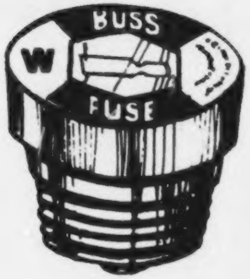
Fustat



Circuit Breaker



Fustron



Fuse

12.3.0 - TM 6

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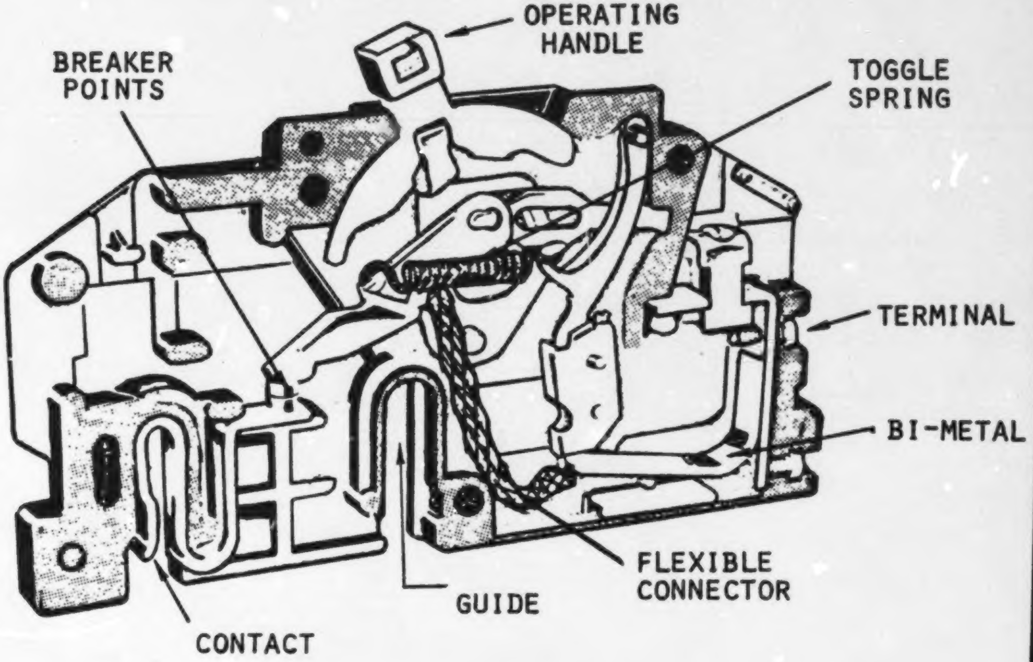
STATE DEPARTMENT OF VOCATIONAL-TECHNICAL EDUCATION
STILLWATER, OKLAHOMA
IML-UMC

# CIRCUIT BREAKER

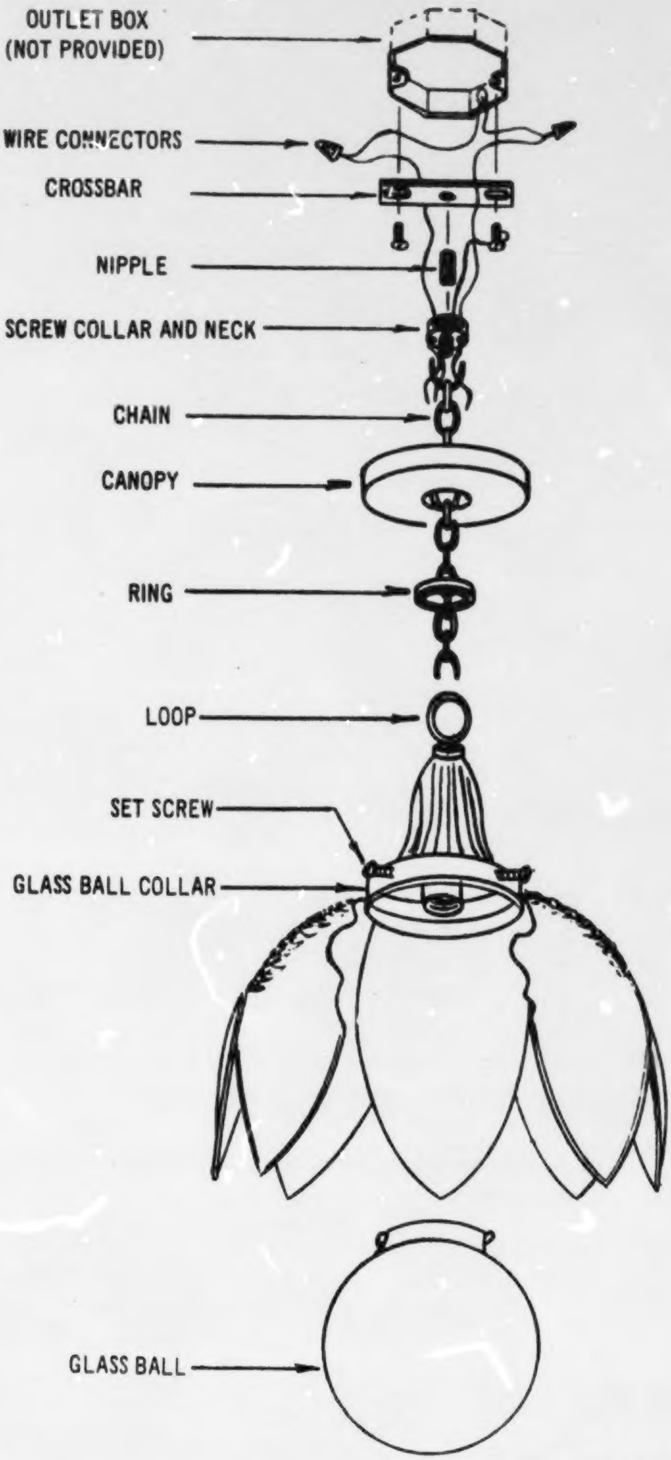


12.3.0 - TM 7

COURTESY OF
CALIFORNIA STATE DEPT. OF EDUCATION
WIRING PART 3

IML-UMC

# FIXTURE PARTS



## ELECTRICAL - COMPLETION
## SECTION 12.3.0

### ASSIGNMENT SHEET #1 - ELECTRICAL MATERIALS, TERMS AND DEFINITIONS

After studying the information in the references, match each term in the right-hand column with the correct description in the left-hand column.

________1. Threaded nipple used for hanging fixtures

________2. Current carrying conductors, both grounded and ungrounded, on a receptacle

________3. A receptacle that has had a connecting fin removed from remote control or separate circuit connections

________4. Splicing technique that leaves an accessible conductor for attachment to a consuming device or grounding terminal

________5. A device that senses temperature variations from a set point and in turn acts to control a circuit

________6. A device that has almost completely eliminated soldering and taping for certain types of splices

________7. Electromagnetic device for remote or automatic control

________8. An electrical device used to step up or step down a primary voltage to a desired secondary voltage

________9. Type of switch used to control a light from two points

________10. Finish trim installed to switch and receptacle outlets

a. Poles

b. Thermostat

c. Hickey

d. 3-way

e. Relay

f. Cover plates

g. Split wired receptacle

h. Wire nuts

i. Transformer

j. Pigtail

ELECTRICAL - COMPLETION
SECTION 12.3.0

ANSWERS TO ASSIGNMENT #1

1. c
2. a
3. g
4. j
5. b
6. h
7. e
8. i
9. d
10. f

## STATEMENT OF OBJECTIVES

**UNIT** 13.0.0 LANDSCAPE DESIGN

**SECT.** 13.1.0 Landscaping The Residential Site

**TERMINAL OBJECTIVE**

UPON COMPLETION OF THIS SECTION, THE LEARNER WILL LANDSCAPE THE HOME SITE ACCORDING TO THE PRINCIPLES OF LANDSCAPE DESIGN AND APPLY THESE PRINCIPLES TOWARD THE FULL POTENTIAL OF A TYPICAL RESIDENTIAL SITE THROUGH ARRANGEMENTS OF STRUCTURES AND PLANTS.

### SPECIFIC OBJECTIVES

After completion of this section, the learner will:

13.1.1 Following the completion of all construction and finishing activities on the exterior of the structure, prepare the finish grade for proper water drainage by notifying the subcontractor previously employed to complete grading and leveling operations according to specification standards and directions included on the architectural drawings.

13.1.2 Layout and construct any special exterior features such as garden walks, retaining walls, privacy or decorative fencing as specified on the architectural drawings.

13.1.3 Locate and construct areas for group tree, shrub or flower plantings as specified on landscape plan.

13.1.4 Locate and plant ornamental trees, shade trees, shurbs and flowers according to directions on the landscape plan and within the planting season dates in the geographic area where site is located.

13.1.5 Prepare earth for seeding by loosening the soil a few inches deep either by hand or mechanical means.

NOTE: GRADING CONTRACTORS WILL GENERALLY PROVIDE FOR SEED BED PREPARATION AND PLANTING IF DESIRED.

13.1.6 Apply a balance fertilizer to the freshly prepared seed bed. Obtain a soil analysis to ascertain fertilizer need from county agricultural extension agent or local business firms specializing in the sale and application of farm fertilizers. Rate of application should be coordinated with need strength of nitrogen, phosphorus and pot ash.

13.1.7 Apply a blend of grass seed appropriate for the climate and suitable for establishing quick germination and cover to stabilize the soil. More permanent grasses usually have a longer germination period and can benefit from a quick cover to help stabilize the soil in the event of excessive moisture. Adjust the rate of application to manufactures recommendations.

13.1.8 Spread a thin cover of wheat or oat straw over the completed seed bed for the purpose of retaining soil moisture in the event of extended dry periods.

> NOTE: BE VERY CAREFUL NOT TO BUILD A LAYER OF STRAW THAT WILL PREVENT ADEQUATE LIGHT TO ENTER FOR HEALTHY GROWTH AFTER GERMINATION.

13.1.9 Install sod to yard areas where a lawn is desired by placing strips of sod firmly adjacent to each other. Follow growers directions for placement and care following placement.

## INSTRUCTIONAL FORMAT

UNIT 13.0.0 LANDSCAPE - DESIGN

SECT. 13.1.0 Landscaping The Residential Site

### INSTRUCTIONAL PROCEDURES

Specific objectives in this section represent knowledge (cognitive) and skill (psychomotor) competencies. It is suggested that specific objectives representing knowledge competencies be used as a basis for presenting instructional materials in classroom situations. Specific objectives representing skill competencies may be used as a basis for presenting skill instruction at the construction site, usually in the form of teacher demonstrations.

I. Suggested activities:

A. Provide learner with statement of objectives sheet

B. Discuss terminal and specific objectives

C. Provide learner with instruction sheets for use with this section

D. Explain evaluation procedures

II. Suggested instructional methods:

A. Demonstration - to show manipulative operations at construction site

B. Discussion - to encourage question and answer activities

C. Team assignment - to enhance personal relationships in the work environment.

D. Illustrated lecture - to introduce a lesson or focus attention

E. Field trips - to illustrate construction techniques and application of materials

F. Consultant - Landscape architect, nurseryman or garden center

III. Instructional materials used in this section:

A. Statement of objectives sheet

B. Information sheet

C. Transparency masters

  1. TM 1 - Lot Grading (see 2.4.0 - TM 1)

  2. TM 2 - Landscaping Do's and Don't's

D. Assignment sheet #1 - Landscape Materials, Terms and Definitions

E. Answers to assignment #1

IV. References:

A. Nelson, William R. Landscaping Your Home. College of Agriculture Cooperative Extension Service, Urbana, Illinois: University of Illinois, 1975.

B. Small Homes Council - Building Research Council. "Fundamentals of Land Design". Circular Series B3-0, Champaign, Illinois: University of Illinois, 1947.

## LANDSCAPING THE RESIDENTIAL SITE
## SECTION 13.1.0

## INFORMATION SHEET - CONTENT OUTLINE

I. Finish grading specifications

  A. Minimum compacted depth of surface soil

    1. Area to be seeded (4")

    2. Area to be sodded (4" minum sod thickness)

  B. Drainage design for surface drainage

    1. Storm drainage

    2. Site drainage

II. Establishing landscape needs

  A. Landscape architect

  B. Nurseryman

  C. Garden center

  D. Planning considerations

    1. "Cube" of space approach

    2. Relationship between living and service areas

    3. Outside appearance

  E. Planning basics

    1. Public area

    2. Living area

    3. Service area

III. Site analyzation factors

  A. Drainage

  B. Existing vegetation

C. Kind of material

D. Plant species

E. Natural features

F. Climate

  1. Temperature

  2. Precipitation

  3. Humidity

  4. Prevailing wind

G. Existing topography

IV. Construction materials

A. Earth

B. Rocks

  1. Boulders

  2. Cobbles

  3. Stone

  4. Loose aggregates

C. Manufactured masonry units

  1. Brick

  2. Tile

  3. Concrete block

  4. Wood

  5. Miscellanious

V. Landscape structures

A. Grading structure

  1. Drywalls

  2. Retaining walls

B. Circulation structures

1. Drives

2. Walks

3. Ramps

4. Steps

C. Surface structures

1. Patio-terrace

2. Service areas

3. Play areas

4. Game courts

5. Decks

D. Enclosure structures

1. Fences

2. Walls

E. Overhead structures

F. Utility structures

VI. Plants

A. Design quality

1. Form

2. Texture

3. Color

B. Principles of design

1. Simplicity (Elimination of non-contributing details to composition)

2. Variety (Diversity and contrast in use of form, texture and color)

3. Balance (Equilibrium on each side of a vertical axis)

4. Emphasis (Differentiating more important elements from less important ones)

5. Sequence (Recurrance of units in linear movement)

6. Scale (Absolute or relative size of objects)

7. Unity (Quality of oneness)

8. Proportion (Ratio of comparative value or size of two quantities)

VII. Trees

A. Cultural purposes

B. Functional purposes

C. Aesthetic considerations

VIII. Shrubs

A. Specimen plants

B. Accent plants

C. Group plantings

D. Shrub borders

E. Hedges

F. Screens

G. Foundation plantings

H. Vines

I. Ground covers

IX. Seeding for lawn developemnt

A. Seedbed preparation

B. Soil analysis

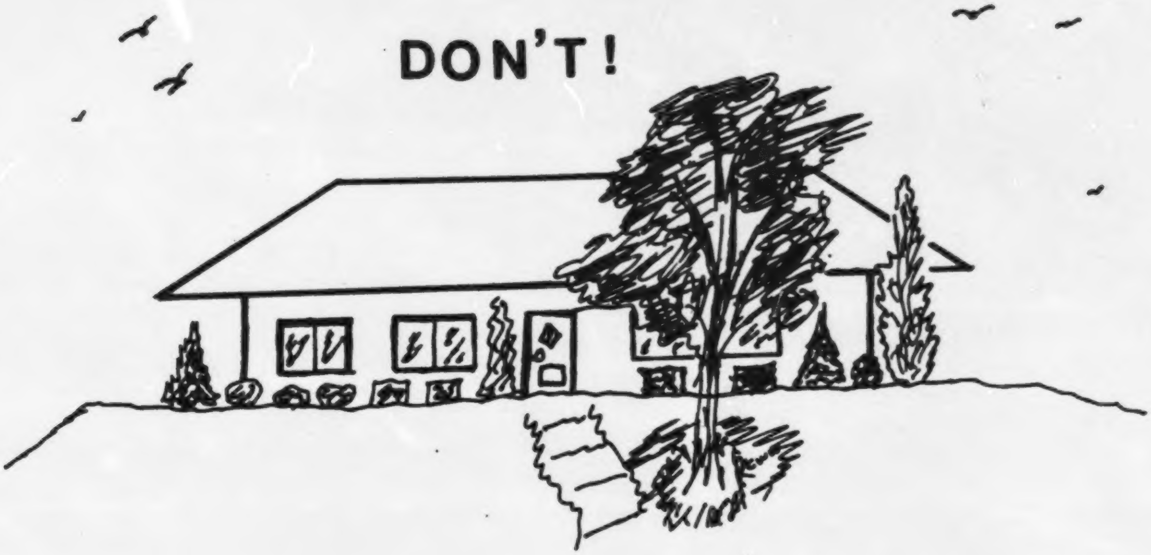
C. Fertilizer

        1. Major elements in percentages
            a. Nitrogen
            b. Phosphorus
            c. Potash
        2. Formula illustrations
            a. 12-12-12
            b. 11-28-0
            c. 5-10-5
    D. Planting seasons
    E. Grass seeds
        1. Blends
        2. Quick growth
        3. Permanent grasses
        4. Germination periods
    F. Protection from excessive moisture loss

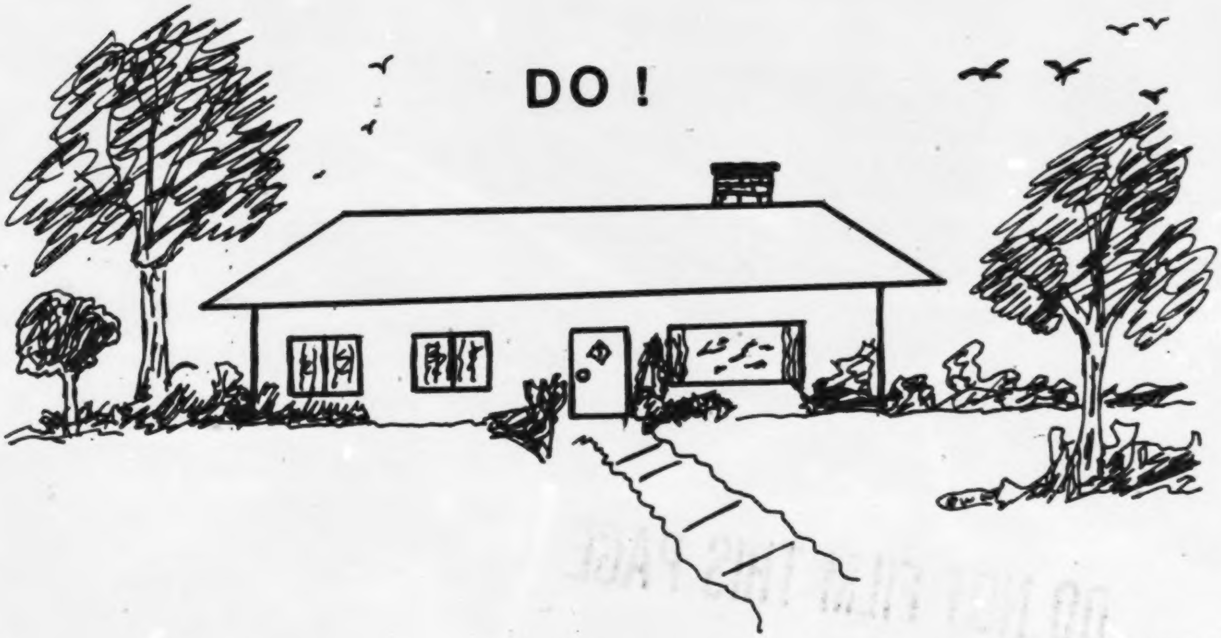
X. Installing sod for lawn development
    A. Source
    B. Soil preparation
    C. Installation
    D. Retaining moisture

# LANDSCAPING DO'S & DON'T'S

**DON'T!**



**DO!**



## LANDSCAPING THE RESIDENTIAL SITE
## SECTION 13.1.0

### ASSIGNMENT SHEET #1 - LANDSCAPE MATERIALS, TERMS AND DEFINITIONS

After studying the information in the references match each term in the right-hand column with the correct description in the left-hand column.

_________1. An area of the residential site located between the road and the house composed of access walks and drives, tree planting, shrub plantings and lawn areas

_________2. An art which serves to creat and preserve the beatuy of the site surrounding the residential structure and assists in making the surroundings useful

_________3. A person who supplies plant materials and will plant according to a carefully prepared plan.

_________4. A quality described as the amount of slope the earth can hold without structural retention when graded into mounds or small hills

_________5. A general term used to describe several types of materials, such as boulders, cobbles, stone and gravel

_________6. A type of wall erected to hold back or support a bank of earth

_________7. The term used to describe a design quality of plant shapes

_________8. The most permanent of all plant materials.

_________9. A growth sustaining product consisting mainly of various percentages of nitrogen, phosphorus and potash

________10. A pre-grown lawn, availabel in strips of topsoil for immediate placement in areas where an "overnight" stand of lawn grass is desired

a. Public

b. Nurseryman

c. Rock

d. Trees

e. Sod

f. Fertilizer

g. Form

h. Retaining

i. Angle of repose

j. Landscape architecture

## LANDSCAPING THE RESIDENTIAL SITE
## SECTION 13.1.0

### ANSWERS TO ASSIGNMENT #1

1. a
2. j
3. b
4. i
5. c
6. h
7. g
8. d
9. f
10. e